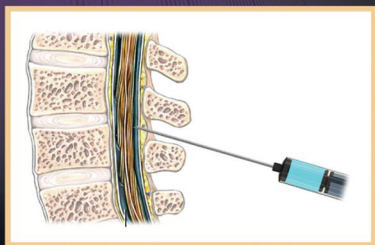


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Pocket Handbook of

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# SPINAL INJECTIONS



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Anupam Sinha

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Gautam Kothari

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**demos**MEDICAL

# **Pocket Handbook of Spinal Injections**

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# Pocket Handbook of Spinal Injections

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# Foreword

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## **A SPINE SURGEON'S PERSPECTIVE**

Spinal injections are an important component in the armamentarium of the modern spine care professional. These procedures serve both as a diagnostic tool and a therapeutic modality. Spinal injections often provide patients with an excellent, nonsurgical treatment option which provides value in the clinical pathway of a variety of spinal pathologies. As with all medical procedures, patient selection and optimal execution of an injection procedure is paramount to the ultimate success of the intervention.

This succinct handbook offers an outstanding overview of spinal injection procedures. It is designed to provide clinicians with a quick, practical guide to the use and execution of spinal injection procedures. The guide is written by experts with substantial clinical experience in the field. I am confident that readers from a wide variety of backgrounds will find the information included in this guide of value.

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# Preface

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The use of fluoroscopically guided injections has revolutionized the treatment of painful spinal conditions. As residents and fellowship applicants, we had minimal exposure to the broad range of interventional techniques used to treat spinal pain. While there are a wide variety of textbooks and atlases (some of which are used as references for this handbook) that serve as excellent guides for any interventionalist, these can be difficult to navigate for individuals in training who often have no prior experience with these techniques.

Our goal with this handbook is to provide a quick, accessible reference for beginning interventionalists who are as yet unfamiliar with procedural spine care. We focus on the basics—C-arm positioning, needle selection, injectables, complications and side-effects, and offer detailed protocols and procedures for treating common spine pathologies. We have also included an appendix with sample dictation templates to help with documentation. The handbook does not describe more advanced procedures such as discography, spinal cord stimulation, or radiofrequency ablation which are somewhat beyond the scope of this abridged overview.

We hope that this text provides a useful adjunct to already established guidelines and references available for

---

spinal intervention. It should be noted, that this handbook is in no way intended to replace appropriate fellowship training in this exciting and diverse field.

Anupam Sinha, DO  
Gautam Kothari, DO

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# Introduction

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The treatment of spinal pathology was revolutionized in the mid-1990s when fluoroscopically guided spinal procedures became the standard of care. Prior to that time, the primary injection options utilized in spinal care included blind epidural steroid and trigger point injections.

X-ray, MRI, and CT scan allow us to understand the anatomy of the patient. However, “pictures do not show pain,” and the clinical significance of the image must be interpreted based on the history and physical. The judicious use of spinal injections in patients with radiculopathy can provide our patients with tremendous relief and often helps us prognosticate which patients might benefit from surgical intervention. For the neurogenic claudication seen in spinal stenosis, fluoroscopy allows us to target the exact level of nerve impingement and significantly improve the placement of medication into the epidural space relative to nonfluoroscopically guided injections.

For the patient with subacute or chronic axial pain, we can test our differential diagnosis of the potential pain generator through a variety of procedures with the aid of fluoroscopy. Painful facet and sacroiliac joints can be identified and treated with short-term treatments such as corticosteroid/anesthetic preparations or potentially longer-term strategies such as radiofrequency ablation. While these injections have

---



the potential to temporarily decrease pain, it will be our task to prove that these procedures are indeed improving the pain and lives of our patients over the long term.

While these injections and procedures can be of great benefit, they are not the only options for treatment of the patient with a painful spine. The treatment of spinal pathology has become increasingly team-oriented. Multidisciplinary programs with surgeons and nonsurgeons provide comprehensive treatment plans that are optimized for the individual patient. Patients should get the most conservative treatment that provides the best outcome.

One of the benefits of the rise in popularity of spinal injections is that we have improved our educational process for the management of spinal pathology; there is a plethora of fellowships available for the proper education of physicians who wish to utilize these techniques. It is important that we guide our spine fellows to become safe and responsible practitioners who know how to use their clinical acumen, knowledge of spinal anatomy, and skills learned during fellowship to provide patients with the best treatments. It is also critical that we teach them a well-balanced approach to spinal care so that they also understand the use of exercise and alternative treatment strategies as well as medications. Finally, function, as well as pain relief, must be the goal of treatment.

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## CHAPTER 1

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# Fluoroscopic Visualization

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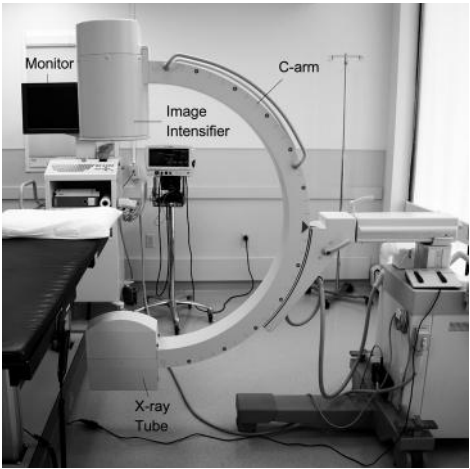
*Ari C. Greis and Anupam Sinha*

### **ANATOMY OF THE FLUOROSCOPE (FIGURE 1.1)**

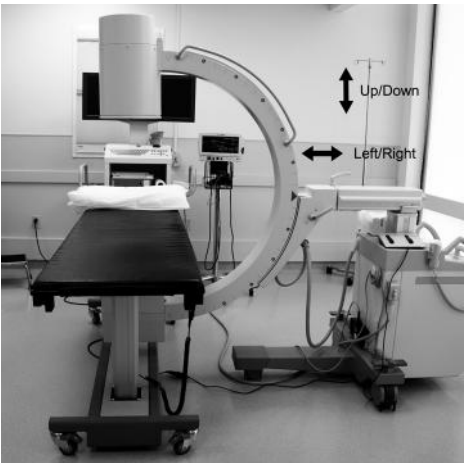
- X-ray tube, image intensifier, C-arm, Monitor

### **ANTEROPOSTERIOR (AP) VIEW (FIGURE 1.2)**

- Used to center the target joint or vertebrae in the middle of the screen.
  - In a “true AP” view the spinous process is centered equidistant between the pedicles.
    - Have the patient turn their head to the opposite side while lying prone to level the back to produce a true AP view, or
    - Oblique the C-arm several degrees to accommodate for suboptimal patient positioning and/or scoliosis.
  - Used to visualize the six o’clock position of the pedicle during transforaminal epidural steroid injections (TFESI) (to avoid a dural puncture).
  - Used to “count up” or “count down” vertebrae when isolating a specific level.
-



**Figure 1.1** Anatomy of the fluoroscope.



**Figure 1.2** Fluoroscope in AP view showing up/down and left/right translation.

### **LATERAL VIEW (FIGURE 1.3)**

- Used to check needle depth within the spinal column.
- Can see the needle tip in line with the lamina for interlaminar epidural steroid injections (ILESIs), within the foramen in TFESI, and in the anterior portion of the sacroiliac (SI) joint for intra-articular SI joint injections.
- For a “true lateral” view, line up the lateral masses or ribs.
- If the “true AP” view requires obliquing past 0° due to scoliosis or suboptimal patient positioning, oblique the C-arm 90° from the “true AP” to get the best lateral view.



**Figure 1.3** Fluoroscope in lateral view.

### **OBLIQUE** (FIGURE 1.4, FIGURE 1.5)

- C-arm rotates to the left or right of the patient's body.
- AP view is at 0° oblique and lateral view is at 90° oblique.
- Used to visualize the “scotty dog” during transforaminal/facet/medial branch injections.
- Used to separate or superimpose the anterior and posterior joint margins of the SI joint.
- Contralateral oblique is used during interlaminar injections when nearing the spinolaminar line.



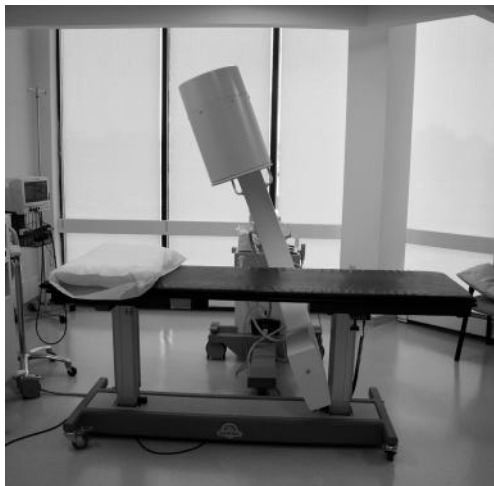
**Figure 1.4** Fluoroscope in right oblique view.



**Figure 1.5** Fluoroscope in left oblique view.

**CEPHALAD-CAUDAD TILT (FIGURE 1.6, FIGURE 1.7)**

- Image intensifier of the C-arm rotates toward the patient's head or feet.
- Used to “square” the vertebral endplates to provide a true AP view, making the target structure more clear.
  - The amount of tilt will vary from patient to patient, but the goal is to visualize the superior endplate of the target vertebrae as a straight line.
  - In patients with a normal lumbar lordosis, the tilt is usually cephalad in the lower lumbar spine and caudad in the upper lumbar spine.



**Figure 1.6** Fluoroscope in cephalad tilt view.



**Figure 1.7** Fluoroscope in caudad tilt view.

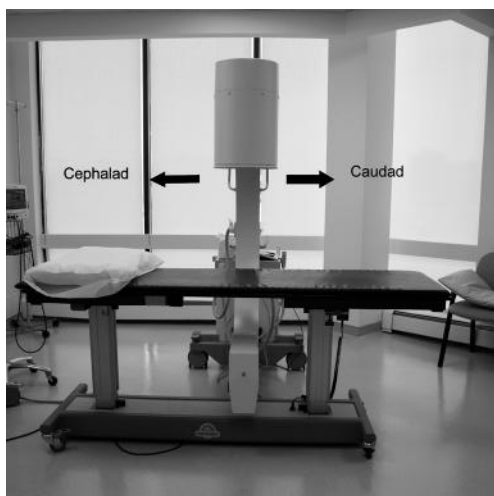
- Cephalad tilt during a SI joint injection can elongate the view of the joint making it easier to visualize the posterior joint margin.
- Cephalad tilt, under oblique view, during an L5 TFESI can move a prominent iliac crest to open up the foramina.

### **RIGHT/LEFT TRANSLATION (SEE FIGURE 1.2)**

- C-arm shifts to the right or left side of the patient's body.
- Used to center the target vertebrae/joint in the field of view.

### **CEPHALAD/CAUDAD TRANSLATION (FIGURE 1.8)**

- C-arm shifts toward the patient's head or feet.
- Used to center the target vertebrae/joint in the field of view.



**Figure 1.8** Fluoroscope in AP view showing cephalad and caudad translation.



### **UP/DOWN (SEE FIGURE 1.2)**

- Image intensifier of the C-arm is moved closer to or farther away from the patient's body.
- The closer the image intensifier is to the patient, the more vertebrae can be visualized in the field of view.

### **SWIVEL**

- The whole C-arm machine is moved around the patient in a clockwise or counterclockwise position.
- Usually done in the lateral view to orient the X-ray beam perpendicular to the target vertebrae.
- Useful in patients who have scoliosis or other spinal deformities.

### **SUGGESTED READING**

Furman MB. *Atlas of Image-Guided Spinal Procedures*. Philadelphia, PA: Elsevier; 2013.

## CHAPTER 2

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# Needle Types and Maneuvering

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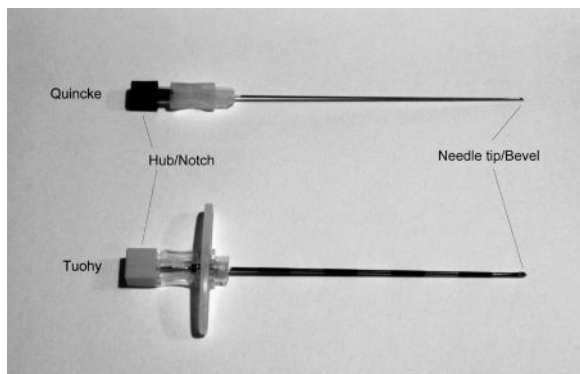
*Gautam Kothari*

### **ANATOMY OF THE NEEDLE (FIGURE 2.1)**

- Needle tip
- Bevel—opening at the tip of the needle
- Hub
- Notch—raised portion of the hub
- Stylet—thin wire within the needle; removed when administering contrast or medication

### **TUOHY NEEDLE**

- Used for interlaminar epidural steroid injections.
  - Larger, smaller gauged, blunt curved tip needles.
  - The notch, bevel, and curved tip face the same direction.
  - Maneuverability is generally unidirectional and mainly in an anterior posterior direction.
  - Larger movements can be made without much change in trajectory.
-



**Figure 2.1** Types of needles: Quincke and Tuohy.

### **SPINAL (OR QUINCKE) NEEDLE**

- Used for transforaminal, caudal, medial branch block (MBB), and joint (facet, sacroiliac, hip) injections.
- The notch and bevel face the same direction.
- When steering the spinal needle, the needle tip will move opposite the direction of the notch and bevel.
- Bending the tip of the needle in the direction of the bevel (up to 30°) allows for increased maneuverability (Figure 2.2).
  - This may be of particular use when trying to avert osteophytes in a degenerated spine, or when navigating a longer needle in a larger person.
- Steering the spinal needle requires smaller, finer movements and generally more use of intermittent fluoroscopy than what is required to navigate the Tuohy needle.



**Figure 2.2** Up to a 30° bend in the direction of the bevel at the tip of a Quincke needle can allow for increased maneuverability.

When categorizing the size of the needles, it is important to remember that there is an inverse relationship between the “number” gauge and the “size” of the needle. The smaller the number gauge needle, the larger diameter it actually is. For example, a 22 gauge needle has a larger diameter than a 25 gauge needle.

### SUGGESTED READING

Fenton DS, Czervionke LF. *Image Guided Spine Intervention*. Philadelphia, PA: Saunders Elsevier; 2003.



## CHAPTER 3

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# Complications and Side Effects

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*Amy Schneider-Lyall and Anupam Sinha*

### LOCAL ANESTHETIC RISKS

- Inadvertent puncture of thecal sac while injecting local anesthetic causes possibility of prolonged paresthesia, pain in legs, transient paralysis (motor block)
- Allergic reactions: vasomotor changes, hives/urticaria, bronchospasms
- Central nervous system toxicity: disorientation, light-headed, nystagmus, tinnitus, muscle twitching, blurred vision, numbness of tongue, metallic taste, slurred speech, headache, seizures
- Cardiovascular vasoconstriction: increased heart rate, dysrhythmia, elevated blood pressure

### CORTICOSTEROIDS RISKS

- Intrathecal injection causes increased risk of arachnoiditis
  - Fluid retention (congestive heart failure, weight gain), steroid myopathy, irregular menstrual cycle, epidural lipomatosis, insomnia, osteoporosis
  - Hyperglycemia (maximum levels usually within 48 hours)
-

- Facial flushing: possibly an immunoglobulin (IgE) mediated mechanism. Usually self-limited but can treat with oral antihistamine for 2 to 3 days
- Less common: increase in temperature, euphoria, depression, mood swings (especially in patients with bipolar disorder), local fat atrophy, depigmentation of skin, headaches, pain flare, Cushing's syndrome, transient adrenal suppression (may take up to 2 weeks for hypothalamus-pituitary axis to resolve)

### CONTRAST DYE RISKS

- Allergic reactions: urticaria, itching, bronchospasm, facial and laryngeal edema (usually occurs within 2 hours)
- Contrast induced nephropathy or thyrotoxicosis

### OTHER RISKS OF SPINAL INJECTIONS

- Vasovagal reaction: blood vessels vasodilate causing blood pressure to temporarily decrease leading to lightheadedness or even fainting
  - Treatment includes: laying the patient in a reverse Trendelenburg position (supine, raised legs, lower the head), loosen tight clothing, monitor vital signs, administer intravenous normal saline
- Meningitis: bacterial or aseptic secondary to a dural puncture
- Epidural abscess/discitis/osteomyelitis
  - Check complete blood count (CBC) and erythrocyte sedimentation rate (ESR); if abnormal, get magnetic resonance imaging (MRI) with and without gadolinium.
  - *Staphylococcus aureus* most common source of infection

- Increased risk of bleeding in patients with hemophilia, Von Willebrand's disease, thrombocytopenia ( $>100K$  platelets is safe), anticoagulation therapy
- Liver or renal disease causes increased risk of epidural hematoma.
- Injury to cauda equina, nerve roots, or spinal cord
- Paralysis: usually secondary to radicular artery or Artery of Adamkiewicz infarct, anterior spinal artery ischemia and cord infarct
- Postdural puncture headache ("spinal headache")
  - Headaches are positional: worse when upright, better when supine
  - Conservative management: hydration, bed rest, analgesics, caffeine, triptans
  - Epidural blood patch may be done in refractory cases (see Chapter 10 for procedure).
- Pneumothorax (during lower cervical or thoracic injections)
- Recurrent laryngeal nerve injury (during cervical injections)
- Urinary retention (local anesthetic effect on sacral roots)

Cervical epidural injections pose an overall increased risk of pneumocephalus, neck pain, headache, insomnia, vasovagal reaction, flushing, spinal cord infarction, neuropathic pain, trauma to a vessel, air embolus/stroke.

### **SUGGESTED READINGS**

- Abbasi A, Malhotra G, Malanga G, Elovic EP, Kahn S. Complications of interlaminar cervical epidural steroid injections: a review of the literature. *Spine*. 2007;32(19):2144–2151.



- Botwin KP, Gruber RD, Bouchias CG, et al. Complications of fluoroscopically guided transforaminal lumbar epidural injections. *Arch Phys Med Rehabil*. 2000; 81:1045–1050.
- Everett CR, Baskin MN, Novoseletsky D, Speech D, Patel R. Flushing as a side effect following lumbar transforaminal epidural steroid injection. *Pain Physician*. 2004;7:427–429.
- Heran MKS, Smith AD, Legiehn GM. Spinal injection procedures: a review of concepts, controversies, and complications. *Radiol Clin N Am*. 2008;46:487–514.
- Slipman CW, Derby R, Simeone FA, Mayer TG. *Interventional Spine an Algorithmic Approach*. Philadelphia, PA: Elsevier; 2008:213–227.

## CHAPTER 4

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# Injectables

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*Gautam Kothari and Anupam Sinha*

### CORTICOSTEROID/ANESTHETIC

- Injectate consists of a corticosteroid preparation as well as an anesthetic and/or saline.
  - Mechanism of action:
    - In the case of radiculopathy, administration of a volume of fluid at or close to an area of stenosis aids in the “washout effect” of harmful inflammatory mediators often present at the site of disc herniation or stenosis.
    - Another more commonly believed rationale is that of a localized and targeted anti-inflammatory effect. Corticosteroids and anesthetic (with anti-inflammatory properties) are delivered in close proximity to the site of pathology thereby maximizing therapeutic benefit.
  - There are a variety of steroid preparations used by clinicians to achieve the desired effect (Table 4.1).
  - A very controversial and debatable topic amongst spinal interventionalists is the use of particulate versus nonparticulate steroid.
  - It is generally considered safe clinical practice to inject a steroid preparation with low or no particulate aggregates in the regions of the spine where the spinal cord and other vascular structures are located. Inadvertent injection of
-

**Table 4.1** Injectable Steroids

<b>Steroid (preservative-free)</b>	<b>Maximum particle size (<math>\mu\text{M}</math>)</b>	<b>Particle aggregation</b>	<b>Appropriate site of injection</b>
Methylprednisolone acetate	>500	Few	Lumbar, joints
Triamcinolone acetonide	>500	Extensive	Lumbar, joints
Betamethasone acetate, betamethasone sodium phosphate	500	Some	Cervical or thoracic (interlaminar only), lumbar, joints
Dexamethasone sodium phosphate	0.5	None	Cervical, thoracic, lumbar

**Table 4.2** Injectable Anesthetics

Anesthetic (preservative-free)	Duration of action (min)
Procaine hydrochloride	30–60
Lidocaine hydrochloride	80–120
Bupivacaine hydrochloride	180–360
Ropivacaine hydrochloride	140–200

particulate corticosteroids into a vertebral or foraminal artery can cause brain and spinal cord embolic infarcts.

- There are a variety of anesthetics used with or without steroid in the injectate mixture (Table 4.2).
  - 1% lidocaine is most commonly used.
  - Bupivacaine or ropivacaine have longer durations and are often used for diagnostic medial branch blocks.
- Injectables administered within the neural axis should be preservative-free. Drugs that contain preservatives have been linked to adverse effects when administered via the central nervous system. *Only use injectables labeled clearly for epidural use.*

## CONTRAST DYE

- Useful for delineating anatomy of the spinal canal, facet joints, and sacroiliac joints.
- Also useful for confirming position of epidural catheters and to rule out subdural or subarachnoid placement.
- Positive contrast agents (radiopaque) absorb X-rays and produce darker shadows, and for this reason are utilized more for spinal intervention.

- Iodine based nonionic contrast agents are more hydrophilic than ionic agents, reducing their subarachnoid and intravenous toxicity.
- Gadolinium based contrasts are considered an acceptable alternative for patients who are hypersensitive/allergic to nonionic contrast medium.
- Alternatively, patients with a dye allergy may be given an allergy prep prior to the injection (see page 24 for iodine allergy protocol).
  - Allergies to shellfish do not increase the risk of reaction to intravenous contrast any more than that of other allergies (Table 4.3).

**Table 4.3** Injectable Contrast Dyes

Contrast type	Generic name	Trade name
Nonionic	Iohexol Iopamidol Ioversol Iodixanol	Omnipaque Isovue Optitray Visipaque
Ionic	Ioxaglate	Hexabrix
Gadolinium based	Gadopentetate dimeglumine Gadodiamide	Magnevist Omniscan

## SUGGESTED READINGS

Benzon H, Chew T, McCarthy R. Comparison of the particle sizes of different steroids and the effect of dilution: a review of the relative neurotoxicities of the steroids. *Anesthesiology*. 2007;106(2):331–338.

- Derby R, Lee SH, Date ES, Lee JH, Lee CH. Size and aggregation of corticosteroids used for epidural injections. *Pain Med.* 2008;9(2):227–234.
- Hodgson PS, Neal JM, Pollock JE, Liu SS. The neurotoxicity of drugs given intrathecally (spinal). *Anesth Analg.* 1999;88:797–809.
- Huston CW. Cervical epidural steroid injections in the management of cervical radiculitis: interlaminar versus transforaminal. A review. *Curr Rev Musculoskelet Med.* 2009;2(1):30–42.
- Newmark JL, Mehra A, Singla AK. Radiocontrast media allergic reactions and interventional pain practice—a review. *Pain Physician.* 2012;15:E665–E675.
- Schabelman E, Witting M. The relationship of radiocontrast, iodine, and seafood allergies: a medical myth exposed. *J Emerg Med.* 2010;39(5):701–707.



## CHAPTER 5

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# Procedure Protocols

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*Anupam Sinha*

### CONSENT

- Prior to any procedure, signed consent from the patient must be obtained. Consent should include explanation of procedure risks and potential complications (see Appendix 2 for sample).

### UNIVERSAL PROTOCOL

- Prior to the start of any procedure, the physician and staff involved should conduct a final verification to confirm the correct patient, procedure, and site.

### PROTOCOL FOR HOLDING ANTICOAGULANTS

- Patients who are on medications that affect clotting mechanisms are at risk for potential hematoma from a spinal procedure. These medications are absolute contraindications when performing procedures within the neural axis, and relative contraindications when performing procedures outside the neural axis
  - The following anticoagulant holding schedule is suggested prior to spinal procedures (clearance and authorization should be obtained from the prescribing physician first):
-



- Hold for 14 days: Ticlopidine (Ticlid)
- Hold for 7 days: Aspirin and Aspirin-containing medications, Clopidogrel (Plavix), Dipyridamole (Persantine/Aggrenox), Cilostazol (Pletal), Pentoxifylline (Trental), Agrylin (Anagrelide), Prasugrel (Effient), Ticagrelor (Brilinta)
- Hold for 5 days: Dabigatran (Pradaxa), Rivaroxaban (Xarelto), Apixaban (Eliquis), Warfarin (Coumadin), nonsteroidal anti-inflammatory medications (NSAIDs)
  - For Warfarin patients, International Normalized Ratio (INR) should be drawn the day before or day of the procedure. INR should be less than 1.5 to proceed with injection
  - NSAIDs should be held for 5 days for cervical and thoracic procedures. It is at the discretion of the individual physician to hold these for lumbosacral and hip procedures
- Hold for 24 to 48 hours: Fondaparinux (Arixtra)
- Hold for 12 to 24 hours: Enoxaparin (Lovenox)
- Hold for 4 hours: Heparin

## **PROTOCOL FOR IODINE OR CONTRAST DYE ALLERGY**

- Patients with a known history of iodine or iodinated contrast allergy may be given a prep prior to their procedure, consisting of the following:
  - Prednisone 50 mg, 13 hours, 7 hours, and 1 hour prior to procedure
  - Diphenhydramine 50 mg, 1 hour prior to procedure
  - Ranitidine 150 mg, 1 hour prior to procedure (*optional, to prevent gastrointestinal irritation from prednisone*)

## **INTRAVENOUS ACCESS**

- Intravenous (IV) access is advisable in first time injection patients.
- IV access may be necessary to administer medications in cases of severe hypotension and allergic reaction after an injection.

## **RADIATION SAFETY**

- Prior to using the C-arm, all physicians and staff within the procedure suite should wear lead apron, thyroid shield, leaded glasses, leaded gloves (if hands are in the field during live fluoroscopy), radiation badge.
- Badges should be exchanged every few months for cumulative radiation dose monitoring.

## **STERILITY**

- Whenever possible, use of single-dose vials is preferred over multiple-dose vials, especially when medications will be administered to multiple patients.
- Needles and syringes are sterile, single-use items; they should not be reused for another patient or to access a medication or solution that might be used for a subsequent patient.
- Chlorhexidine or povidone-iodine should be used to cleanse the patient's skin prior to the injection.

## **AFTER THE INJECTION**

- Clean off the patient with alcohol and dress the injection site.
- Escort the patient off the table to prevent falls.

- Check postprocedure vital signs.
- Follow up in office in 2 to 3 weeks.

## FREQUENCY OF INJECTIONS

- There is no commonly accepted medical standard regarding the frequency or acceptable maximum number of spinal corticosteroid injections.
- There is no evidence to support the common practice of a series of injections.
- In the opinion of the authors, the following guidelines are recommended:
  - Facet joint: two injections, 2 to 3 weeks apart. May repeat in 2 to 3 months if there is greater than 50% relief. Limit to three to four injections per year.
  - Sacroiliac joint: three to four injections per year.
  - Epidural injections: three injections in a 6 month period, or four in a year. These should be spaced at least 2 weeks apart.

## SUGGESTED READINGS

- Douketis JD, Spyropoulos AC, Spencer FA, et al. Perioperative management of antithrombotic therapy: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. American College of Chest Physicians. *Chest*. 2012;141(2 suppl):e326S–e350S.
- Novak S, Nemeth WC. The basis for recommending repeating epidural steroid injections for radicular low back pain: a literature review. *Arch Phys Med Rehabil*. 2008;89(3):543–552.

- Ortel TL. Perioperative management of patients on chronic antithrombotic therapy. *Hematology Am Soc Hematol Educ Program*. 2012:529–535.
- Pauza, K. Educational guidelines for interventional spinal procedures. 2008. [www.aapmr.org/practice/guidelines/Documents/edguidelines.pdf](http://www.aapmr.org/practice/guidelines/Documents/edguidelines.pdf).
- Siegel JD, Rhinehart E, Jackson M, Chiarello L; Healthcare Infection Control Practices Advisory Committee. *2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings*. [www.cdc.gov/hicpac/pdf/isolation/Isolation2007.pdf](http://www.cdc.gov/hicpac/pdf/isolation/Isolation2007.pdf).



## CHAPTER 6

# Cervical Injections

*Gautam Kothari and Lisa Marino*

### CERVICAL INTERLAMINAR EPIDURAL STEROID INJECTION (ILES)

- **Indications:** cervical radiculopathy, herniated nucleus pulposus, cervical stenosis
- **Contraindications:** systemic or local site infection, bleeding diathesis, weakness, severe central stenosis, or decreased spinal canal diameter ( $<7$  mm) with myelopathic symptoms
- **Needle:** 18- or 20-gauge, 3½ inch (or larger) Tuohy needle
- **Injectate volume:** 3 mL 0.9% normal saline and 8 to 10 mg dexamethasone (or 12 mg betamethasone)
- **Contrast volume:** up to 4 mL
- **C-arm positions used:** anteroposterior (AP), lateral, contralateral oblique

#### Procedure

1. Prep and drape the patient in a sterile fashion in the prone position.
2. Using fluoroscopic visualization, identify the interlaminar space (usually C7-T1) in AP view.

3. Tilt the fluoroscope cephalad or caudad to maximize the space.
4. Oblique the fluoroscope slightly toward the side of symptomatology.
5. Using a 25-gauge needle, anesthetize the skin over the site of entry with 1% lidocaine.
6. Insert Tuohy needle over the anesthetized skin.
7. Use biplanar imaging to advance the needle toward the spinolaminar line.
8. Use a loss of resistance technique and make sure there is negative aspirate for air, blood, and cerebrospinal fluid (CSF).
9. Connect extension tubing to the needle and under live fluoroscopy inject contrast dye in both lateral (or contralateral oblique) and AP views (Figures 6.1, 6.2, and 6.3).
10. Extreme care should be taken to look for vascular uptake. Digital subtraction can also be used to ensure absence of vascular flow. *If arterial flow or subdural flow is seen the procedure should be aborted.*
11. Inject the steroid mixture.
12. Observe the patient postprocedure to assure no adverse reaction.

### Pearls

- Care should be taken not to advance the needle past the spinolaminar line.
- Biplanar imaging should be performed to assure safe needle advancement and visualize depth.
- C6-7 is the highest level an interlaminar injection should be performed due to failure of ligamentum

flavum fusion above this level. Risk of venous contrast flow is increased as well due to the presence of a venous plexus above this level.

- The contralateral oblique view (45–60° from AP) can be used to better visualize the needle as it approaches the spinolaminar line since the shoulders can often obscure the image in lateral view.
- Vascular uptake is seen as rapidly dissipating contrast during live fluoroscopy.

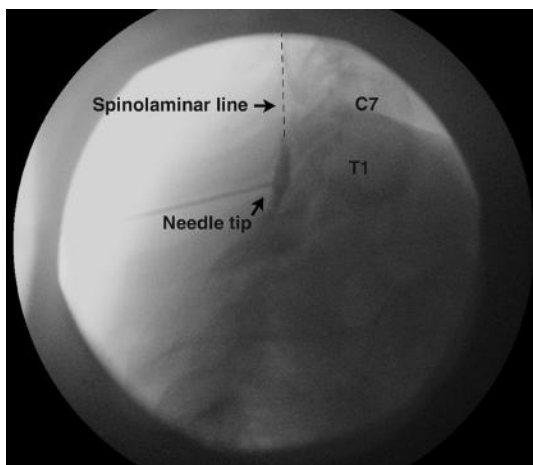


**Figure 6.1** Postcontrast cervical ILES in AP view.





**Figure 6.2** Postcontrast cervical ILESi in contralateral oblique view.



**Figure 6.3** Postcontrast cervical ILESi in lateral view.

## CERVICAL TRANSFORAMINAL EPIDURAL STEROID INJECTION (TFESI)

- **Indications:** cervical radiculopathy, herniated nucleus pulposus, cervical stenosis
- **Contraindications:** systemic or local site infection, bleeding diathesis, weakness, severe central stenosis with myelopathic symptoms
- **Needle:** 22- or 25-gauge, 1½ or 2½ inch Quincke spinal needle
- **Injectate volume:** 1 mL 1% lidocaine and 8 to 10 mg dexamethasone
- **Contrast volume:** up to 4 mL
- **C-arm positions:** AP, lateral

### Procedure

1. Prep and drape the patient in a sterile fashion in the supine oblique position (head rotated 45° to contralateral side) with both shoulders depressed to prevent obstruction of view.
2. Using fluoroscopic visualization, identify the targeted neuroforamen in the lateral view with visualization of the superior articular process (SAP).
3. Using a 25-gauge needle, anesthetize the skin over the site of entry with 1% lidocaine.
4. Insert spinal needle over the target of the SAP of the neuroforamen.
5. Advance the needle in the lateral view to the anterior aspect of the SAP at a level even with an imagi-

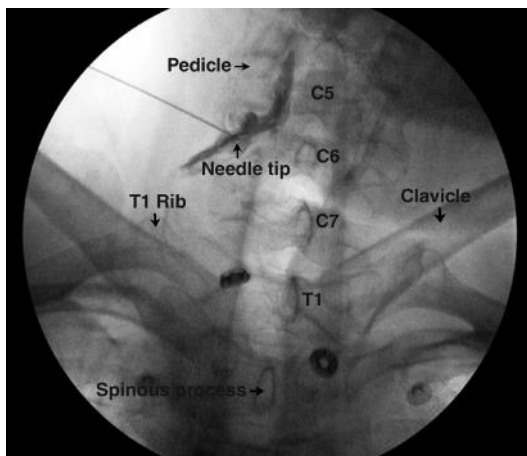
nary line through the midpoint of the neuroforamen from its superior to inferior portion.

- This is done to gauge depth and avoid inadvertent puncture of the dural, spinal cord, and vertebral artery.
6. After bony contact with the SAP, the needle is then repositioned slightly caudal and anterior just into the posterior part of the neuroforamen in the lateral view.
  7. In the AP view the needle tip should be at or just lateral to the six o'clock position of the pedicle (*medial to that point increases the risk of dural puncture*).
  8. Connect extension tubing to the needle and under live fluoroscopy inject contrast dye in both lateral and AP views (Figures 6.4 and 6.5).
  9. Extreme care should be taken to look for vascular uptake. Digital subtraction can also be used to ensure absence of vascular flow. *If arterial flow is seen, the procedure should be aborted.*
  10. Inject 1 mL of 1% lidocaine as a test dose. Assess the patient via verbal questioning initially and again at 60 seconds post-lidocaine injection for: ringing in the ears, metallic taste in the mouth, numbness in the lips, and palpitations in the chest, ability to wiggle their fingers and toes. *If the patient demonstrates any adverse symptoms of intravascular lidocaine uptake, then procedure should be aborted.*
  11. If the patient has no reaction after one minute, inject 8 to 10 mg of dexamethasone.
  12. Observe the patient postprocedure to assure no adverse reaction.

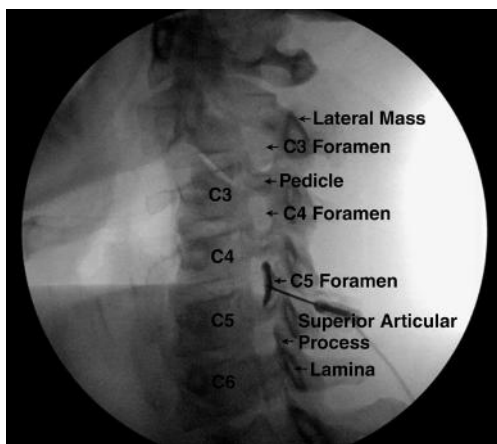
**Pearls**

- Neurovascular risks of this procedure are high, particularly if particulate steroid is used.
- Inadvertent intravascular injection may result in embolism of vasculature structures and spinal cord infarction.
- Vascular uptake is seen as rapidly dissipating contrast during live fluoroscopy.
- Digital subtraction is highly recommended to visualize vascular contrast flow.
- The arterial structures most at risk for inadvertent puncture include the vertebral artery and the radicular spinal arteries.
- Bilateral cervical transforaminal injections are not recommended due to the risk of anesthetizing the spinal nerves controlling the diaphragm bilaterally, potentially causing respiratory distress.
- Multiple levels on a single side should be done with caution as the contrast spread from the first injection can obscure anatomical landmarks for the second injection.

*(Continued)*



**Figure 6.4** Postcontrast cervical TFESI in AP view.



**Figure 6.5** Postcontrast cervical TFESI in oblique view.

**CERVICAL INTRA-ARTICULAR FACET INJECTION**

- **Indications:** cervical pain due to facet joint arthropathy, cervicogenic headaches
- **Contraindications:** systemic or local site infections, bleeding diathesis
- **Needle:** 22- or 25-gauge, 1½ or 2½ inch Quincke spinal needle
- **Injectate volume:** 0.5 mL 1% lidocaine and 3 mg beta-methasone (or 4 mg dexamethasone)
- **Contrast volume:** no more than 0.5 mL
- **C-arm positions:** AP, lateral, ipsilateral oblique

**Procedure****Posterior approach:**

1. Prep and drape the patient in a sterile fashion in the prone position.
2. Confirm the level by rotating the fluoroscope from the AP to the lateral position.
3. Tilt the C-arm caudally, so that the superior and inferior articular borders are visualized.
4. The target site is the lateral half of the joint to be injected.
5. Using a 25-gauge needle, anesthetize the skin over the site of entry with 1% lidocaine.
6. Insert spinal needle over the anesthetized skin, parallel to the trajectory of the fluoroscope.
7. Using intermittent fluoroscopy, advance the needle until bone is engaged.

8. Rotate the C-arm to the lateral position to confirm depth and assure that the needle is not placed too anteriorly within the neural foramen.
9. Connect extension tubing to the needle and under live fluoroscopy inject a trace amount of contrast dye. *An intra-articular pattern is usually seen as a straight line* (Figure 6.8).
10. Inject the steroid mixture.
11. Observe the patient postprocedure to assure no adverse reaction.

**Lateral decubitus approach (a foam pillow is placed under the patient's head to keep the neck parallel to the table):**

1. Prep and drape the patient in a sterile fashion in the lateral decubitus position.
2. Slightly rotate the fluoroscope anteriorly and posteriorly.
  - The proximal joint moves in the same direction that the fluoroscope is rotated.
  - *The joints on each side of the spine overlap thus it is important to identify the correct side.*
3. Cephalad or caudal tilt can also be used to align the joints.
4. The target site is the mid-portion of the inferior articular process (just superior to the intra-articular space targeted).
5. Using a 25-gauge needle, anesthetize the skin over the site of entry with 1% lidocaine.
6. Insert spinal needle over the anesthetized skin, parallel to the trajectory of the fluoroscope.
7. Using intermittent fluoroscopy, advance the needle until bone is engaged.

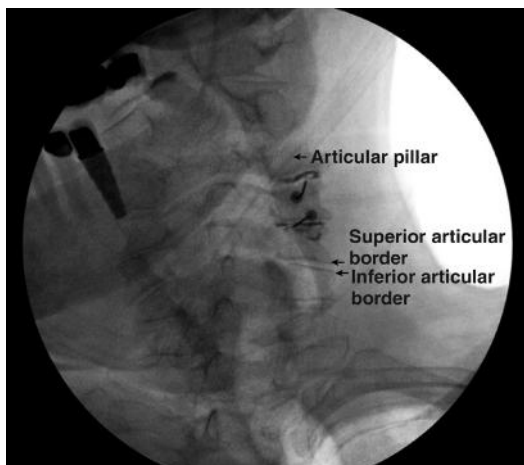
8. Once bone is abutted the needle tip can be repositioned (or walked off) caudally into the joint.
9. Connect extension tubing to the needle and under live fluoroscopy inject a trace amount of contrast dye. *An intra-articular pattern is usually seen as a straight line* (Figures 6.7 and 6.8).
10. Inject the steroid mixture.
11. Observe the patient postprocedure to assure no adverse reaction.

### Pearls

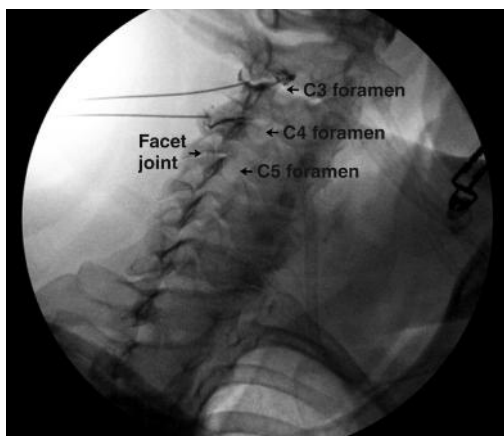
- If an osteophytic ridge prevents passage into the joint, the needle can be repositioned slightly posterior to the mid-portion of the joint to gain access.
- The posterior portion is suggested to avoid the vertebral artery and spinal nerve close to the anterior portion.
- Care should be taken not to advance the needle tip too far medially to avoid contact of vascular structures and the spinal cord.
- With regards to the lower cervical segments, care should be taken to avoid inadvertent contact with the lung apices.

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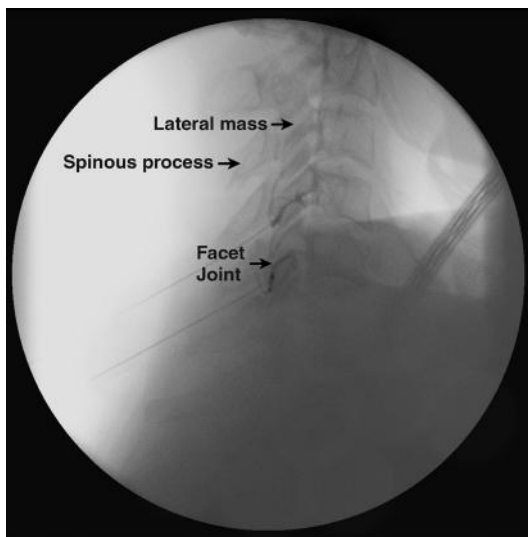




**Figure 6.6** Postcontrast cervical facet joint injection in AP view.



**Figure 6.7** Postcontrast cervical facet joint injection in oblique view.



**Figure 6.8** Postcontrast cervical facet joint injection in lateral view.

**CERVICAL MEDIAL BRANCH BLOCK (MBB)**

- **Indications:** diagnosis of cervical facet mediated pain syndrome
- **Contraindications:** systemic or local site infection, bleeding diathesis
- **Needle:** 22- or 25-gauge, 1½ or 2½ inch Quincke spinal needle
- **Injectate volume:** 0.5 mL 1% lidocaine (or 0.25% – 0.75% bupivacaine) per medial branch
- **Contrast volume:** up to 0.5 mL
- **C-arm positions:** AP, lateral, ipsilateral oblique

**Procedure****Posterior approach:**

1. The patient is prepped and draped in a sterile fashion in the prone position.
2. Confirm the level by rotating the fluoroscope from the AP to the lateral position.
3. Tilt the C-arm caudally to identify the “waist” of the articular pillar.
4. A slight ipsilateral oblique view can be helpful to guide needle entry.
5. Using a 25-gauge needle, anesthetize the skin over the site of entry with 1% lidocaine.
6. Insert spinal needle over the anesthetized skin, parallel to the trajectory of the fluoroscope.
7. Using intermittent fluoroscopy, advance the needle toward the articular pillar.
  - Final needle position is variable depending on the target facet joint medial branch.

- To block the third occipital nerve, the target area is the inferior lateral portion of the C2-C3 facet joint.
  - To block the C5 medial branch, the target point of the needle is the middle segment of the articular pillar.
  - For the remainder of the levels, the target is the superior aspect of the articular pillar.
8. Once the pillar is engaged in the AP view, rotate the C-arm to the lateral position to assess for needle depth and assure the needle has not passed into the neural foramen.
  9. Connect extension tubing to the needle and under live fluoroscopy inject contrast dye (Figure 6.9).
  10. Inject the anesthetic mixture.
  11. Observe the patient postprocedure to assure no adverse reaction.

### **Lateral approach:**

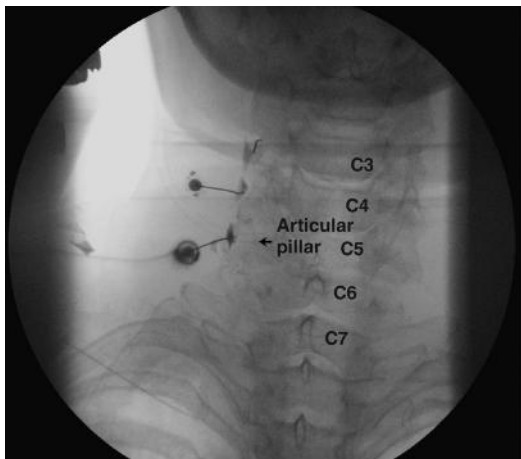
*The procedure may also be done in the lateral decubitus position. This approach is a worthwhile consideration when unilateral procedures are performed. Bilateral injections using this approach would require doing one side at a time and significant patient positioning.*

1. The patient is placed in the lateral decubitus position with the symptomatic side up.
2. Confirm the level to be injected using the lateral view.
3. C2 is used as a reference level for numbering.
4. Tilt and oblique the C-arm to obtain a superimposed pillar view.
5. The target site depends on the medial branch in question (see Posterior approach).

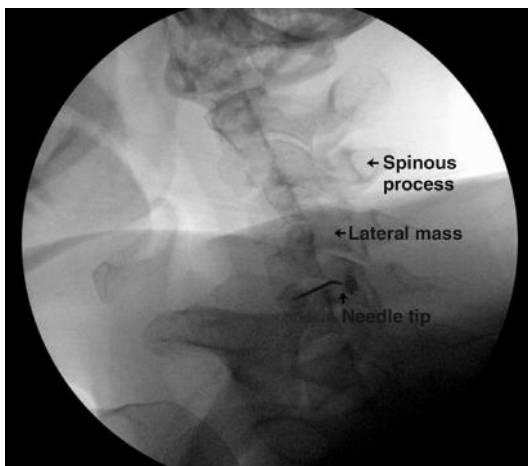
6. Using a 25-gauge needle, anesthetize the skin over the site of entry with 1% lidocaine.
7. Insert spinal needle over the anesthetized skin, parallel to the trajectory of the fluoroscope.
8. Using intermittent fluoroscopy, advance the needle until the pillar is contacted.
9. Connect extension tubing to the needle and under live fluoroscopy inject contrast dye (Figure 6.10).
10. Inject the anesthetic mixture.
11. Observe the patient postprocedure to assure no adverse reaction.

### **Pearls**

- Cervical MBBs are used mainly for the purpose of diagnosing painful cervical facet arthropathy.
- Injection of corticosteroid is not indicated to block the medial branch nerve.
- A double block paradigm with use of a pain diary is helpful in determining whether or not cervical medial branch neurotomy would be beneficial.
- Biplanar imaging is used to ensure safe needle placement.
- It should be noted that the location of the medial branches have a high degree of anatomic variability. This is especially the case with the third occipital nerve and the C5 medial branch. These considerations are more important if the patient is deemed an appropriate candidate for cervical medial branch neurotomy.



**Figure 6.9** Postcontrast cervical MBB (posterior approach) in AP view.



**Figure 6.10** Postcontrast cervical MBB (lateral decubitus approach) in oblique view.

## SUGGESTED READINGS

- Bogduk N, ed. *Practice Guidelines for Spinal Diagnostic and Treatment Procedures*. 2nd ed. San Francisco, CA: International Spine Intervention Society (ISIS); 2013.
- Fenton DS, Czervionke LF. *Image Guided Spine Intervention*. Philadelphia, PA: Saunders Elsevier; 2003.
- Furman M, Jasper NR, Lin H. Fluoroscopic contralateral oblique view in interlaminar interventions: a technical note. *Pain Medicine*. 2010;13:1389-1396.
- Furman, MB. *Atlas of Image-Guided Spinal Procedures*. Philadelphia, PA: Elsevier; 2013.
- Slipman C, Derby R, Simeone F, Mayer T, eds. *Interventional Spine: An Algorithmic Approach*. Philadelphia, PA: Saunders Elsevier; 2008.

## CHAPTER 7

# Thoracic Injections

*Gautam Kothari*

### THORACIC INTERLAMINAR EPIDURAL STEROID INJECTION (ILES)

- **Indications:** thoracic radiculopathy, thoracic herniated nucleus pulposus, thoracic stenosis
- **Contraindications:** systemic or local site infection, bleeding diathesis, weakness, severe central stenosis, or decreased spinal canal diameter ( $<7$  mm)
- **Needle:** 18- or 20-gauge,  $3\frac{1}{2}$  inch (or larger) Tuohy needle
- **Injectate:** 4 mL 0.9% normal saline and 8 to 10 mg dexamethasone (or 12 mg betamethasone)
- **Contrast volume:** up to 4 mL
- **C-arm positions:** Anteroposterior (AP), lateral, contralateral oblique

Procedure
<ol style="list-style-type: none"><li>1. Prep and drape the patient in a sterile fashion in the prone position.</li><li>2. Using fluoroscopic visualization, identify the target interlaminar space in AP view.</li></ol>



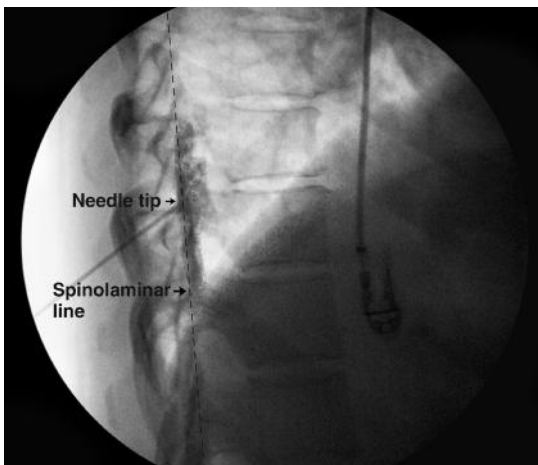
3. Tilt the fluoroscope caudad to maximize the space.
4. Oblique the fluoroscope slightly toward the side of symptomatology.
5. Using a 25-gauge needle, anesthetize the skin over the site of entry with 1% lidocaine.
6. Insert Tuohy needle over the anesthetized skin.
7. Use biplanar imaging to advance the needle toward the spinolaminar line.
8. Use a loss of resistance technique and make sure there is negative aspirate for air, blood, and CSF.
9. Connect extension tubing to the needle and under live fluoroscopy inject contrast dye in both lateral and AP views (Figures 7.1 and 7.2).
10. Extreme care should be taken to look for vascular uptake. Digital subtraction can also be used to ensure absence of vascular flow. *If arterial flow or subdural flow is seen, the procedure should be aborted.*
11. Inject the steroid mixture.
12. Observe the patient postprocedure to assure no adverse reaction.

### Pearls

- Care should be taken not to advance the needle past the spinolaminar line.
- Biplanar imaging should be performed to adequately visualize depth.
- The contralateral oblique view (45°–60° from AP) can be used to better visualize the needle as it approaches the spinolaminar line.
- Vascular uptake is seen as rapidly dissipating contrast during live fluoroscopy.



**Figure 7.1** Postcontrast thoracic ILES in AP view.



**Figure 7.2** Postcontrast thoracic ILES in lateral view.

**THORACIC TRANSFORAMINAL EPIDURAL STEROID INJECTION (TFESI)**

- **Indications:** thoracic radiculopathy, thoracic herniated nucleus pulposus, thoracic stenosis
- **Contraindications:** local or systemic site infections, bleeding diathesis, weakness
- **Needle:** 22- or 25-gauge, 3½ inch (or longer) Quincke spinal needle
- **Injectate volume:** 2 mL 0.9% normal saline and 8 to 10 mg dexamethasone
- **Contrast volume:** up to 4 mL
- **C-arm positions:** AP, ipsilateral oblique, lateral

**Procedure**

1. Prep and drape the patient in a sterile fashion in the prone position.
2. Using fluoroscopic visualization, identify the target level in AP view.
3. Tilt the fluoroscope either cephalad or caudad to square the endplate.
4. Oblique the fluoroscope ipsilaterally.
5. Using a 25-gauge needle, anesthetize the skin over the site of entry (the lower third of the foramen) with 1% lidocaine.
6. Insert spinal needle over the anesthetized skin, parallel to the trajectory of the fluoroscope.
7. Using intermittent fluoroscopy, advance the needle toward the foramen using both oblique and AP views.
8. The target is a region bordered medially by the SAP of the inferior level, superiorly by the inferior

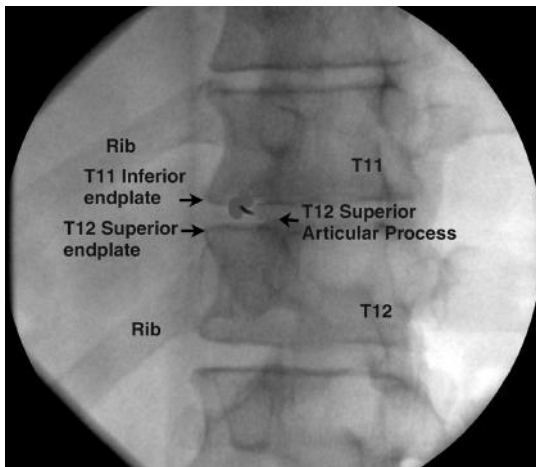
endplate, inferiorly by the superior endplate, and laterally by the rib (Figure 7.3).

9. As the needle approaches the target, point the needle tip superiorly to avoid needle placement into the disc space.
10. Use biplanar imaging to confirm depth and final needle placement.
11. Connect extension tubing to the needle and under live fluoroscopy inject contrast dye in both lateral and AP views (Figures 7.4 and 7.5).
12. Extreme care should be taken to look for vascular uptake. Digital subtraction can also be used to ensure absence of vascular flow. *If arterial flow or subdural flow is seen, the procedure should be aborted.*
13. Inject the steroid mixture.
14. Observe the patient postprocedure to assure no adverse reaction.

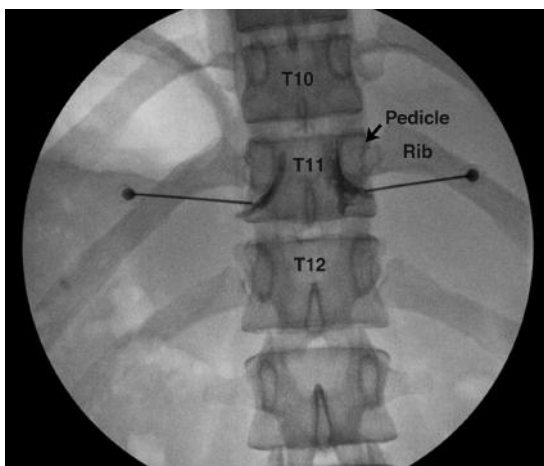
## Pearls

- Risks of thoracic transforaminal injections are similar to that of cervical transforaminal injections. Inadvertent intravascular injection can result in embolization of vascular structures and infarction.
- Vascular uptake is seen as rapidly dissipating contrast during live fluoroscopy.
- The artery of Adamkiewicz can be found entering the spinal canal through a single foramen, between T7 and L4, more commonly on the left from T9 to L2.
- Care must also be taken to avoid the lung fields. This can be achieved by maintaining needle placement in the lower third of the foramen.

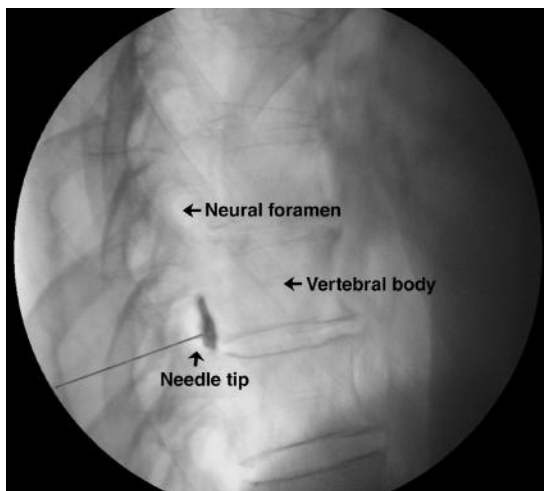
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**Figure 7.3** Needle in oblique view for thoracic TFESI.



**Figure 7.4** Postcontrast bilateral thoracic TFESI in AP view.



**Figure 7.5** Postcontrast thoracic TFESI in lateral view.

### SUGGESTED READINGS

- Bogduk N, ed. *Practice Guidelines for Spinal Diagnostic and Treatment Procedures*. 2nd ed. San Francisco, CA: International Spine intervention Society (ISIS); 2013.
- Fenton DS, Czervionke LF. *Image Guided Spine Intervention*. Philadelphia, PA: Saunders Elsevier; 2003.
- Furman M, Jasper NR, Lin H. Fluoroscopic contralateral oblique view in interlaminar interventions: a technical note. *Pain Medicine*. 2010;13:1389–1396.
- Slipman C, Derby R, Simeone F, Mayer T, eds. *Interventional Spine: An Algorithmic Approach*. Philadelphia, PA: Saunders Elsevier; 2008.



## CHAPTER 8

# Lumbar Injections

*Gautam Kothari, Anupam Sinha, and Madhuri Dholakia*

### LUMBAR INTERLAMINAR EPIDURAL STEROID INJECTION (ILES)

- **Indications:** lumbar radiculopathy, lumbar herniated nucleus pulposus, lumbar stenosis
- **Contraindications:** systemic or local site infection, bleeding diathesis, weakness
- **Needle:** 18- or 20-gauge, 3½ inch (or larger) Tuohy needle
- **Injectate:** 3 mL 0.9% normal saline (or 1% lidocaine) and 12 mg betamethasone (or 80 mg triamcinolone)
- **Contrast volume:** up to 4 mL
- **C-arm positions used:** Anteroposterior (AP), lateral, contralateral oblique

#### Procedure

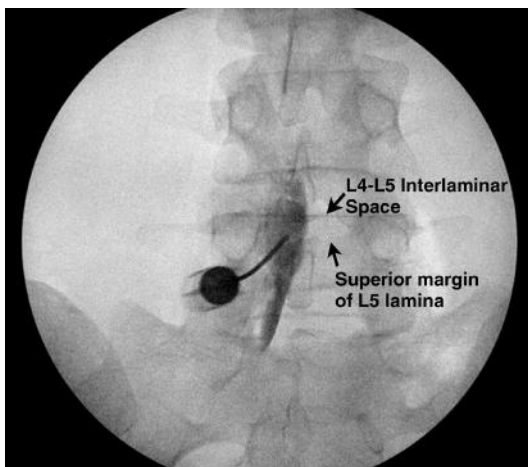
1. Prep and drape the patient in a sterile fashion in the prone position.
2. Using fluoroscopic visualization, identify the target interlaminar space in AP view.
3. Tilt the fluoroscope cephalad or caudad to maximize the space.



4. Using a 25-gauge needle, anesthetize the skin over the site of entry with 1% lidocaine.
5. Insert Tuohy needle over the anesthetized skin.
6. Use biplanar imaging to advance the needle toward the spinolaminar line, targeting the interlaminar space on the symptomatic side.
7. Use a loss of resistance technique and make sure there is negative aspirate for air, blood, or cerebrospinal fluid.
8. Connect extension tubing to the needle and under live fluoroscopy inject contrast dye to assure no intrathecal or intravascular penetration (Figures 8.1 and 8.2).
9. Inject the steroid mixture.
10. Observe the patient postprocedure to assure no adverse reaction.

### **Pearls**

- Care should be taken not to advance the needle past the spinolaminar line to avoid dural puncture.
- Biplanar imaging should be performed to assure safe needle advancement and visualize depth.
- Care should be taken when performing interlaminar epidural steroid injections at levels of spondylolisthesis; there is an increased risk of dural puncture due to epidural space and dural sac narrowing at these levels.
- The contralateral oblique view (45°–60° from AP) can be used to better visualize the needle as it approaches the spinolaminar line, especially if needle position and landmarks are poorly visualized in a lateral view due to large body habitus, severe osteoporosis, or the presence of bowel gas.
- Vascular uptake is seen as rapidly dissipating contrast during live fluoroscopy.



**Figure 8.1** Postcontrast lumbar ILESi in AP view.



**Figure 8.2** Postcontrast lumbar ILESi in lateral view.

**CAUDAL EPIDURAL STEROID INJECTION (ESI)**

- **Indications:** lumbar radiculopathy, herniated nucleus pulposus, lumbar stenosis, prior lower lumbar laminectomy, or fusion
- **Contraindications:** systemic or local site infection, bleeding diathesis, weakness
- **Needle:** 22- or 25- gauge, 3½ inch (or longer) Quincke spinal needle
- **Injectate:** 5 mL 0.9% normal saline, 3 mL 1% lidocaine, and 12 mg betamethasone (or 80 mg triamcinolone)
- **Contrast volume:** up to 4 mL
- **C-arm positions used:** AP, lateral

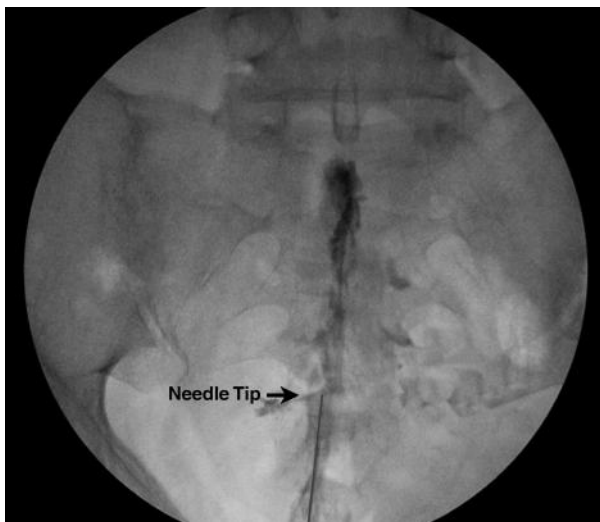
**Procedure**

1. Prep and drape the patient in a sterile fashion in the prone position.
2. Using fluoroscopic visualization, identify the sacral hiatus in lateral view.
3. Using a 25-gauge needle, anesthetize the skin over the site of entry with 1% lidocaine.
4. Insert spinal needle over the anesthetized skin at a 30° angle to the sacrum.
5. Advance needle tip into the sacral hiatus, continuing parallel to the sacrum.
6. Use biplanar imaging to advance the needle to the S3 segment.
7. Connect extension tubing to the needle and under live fluoroscopy inject contrast dye to assure no intrathecal or intravascular penetration (Figures 8.3 and 8.4).

8. Inject the steroid mixture.
9. Observe the patient postprocedure to assure no adverse reaction.

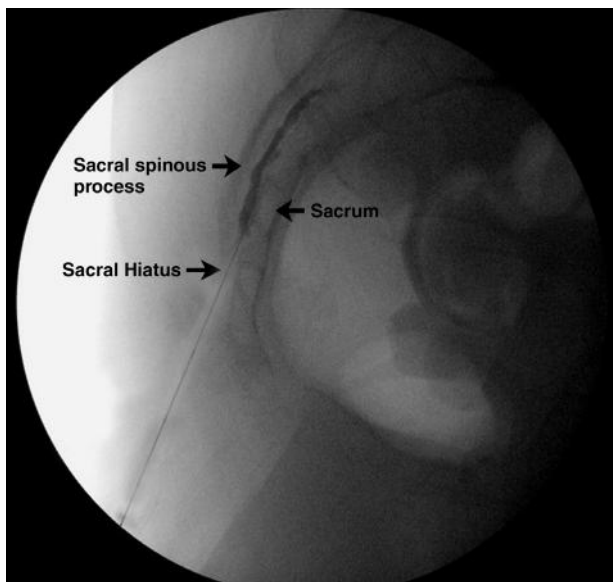
### Pearls

- Entering the sacral hiatus at too steep an angle will make it difficult to advance the needle due to bony contact with the sacral segments.
- A larger volume of injectate is needed to reach the lower lumbar nerve roots.
- Biplanar imaging should be performed to adequately visualize depth.
- Vascular uptake is seen as rapidly dissipating contrast during live fluoroscopy.



**Figure 8.3** Postcontrast caudal ESI in AP view.

*(Continued)*



**Figure 8.4** Postcontrast caudal ESI in lateral view.

## LUMBAR TRANSFORAMINAL EPIDURAL STEROID INJECTION (TFESI)

- **Indications:** lumbar radiculopathy, lumbar herniated nucleus pulposus, lumbar stenosis
- **Contraindications:** systemic or local site infection, bleeding diathesis, weakness
- **Needle:** 22- or 25-gauge, 3½ inch (or longer) Quincke spinal needle
- **Injectate volume:** 2 mL 0.9% normal saline (or 1% lidocaine) and 12 mg betamethasone (or 8–10 mg dexamethasone)
- **Contrast volume:** up to 4 mL
- **C-arm positions:** AP, ipsilateral oblique, lateral

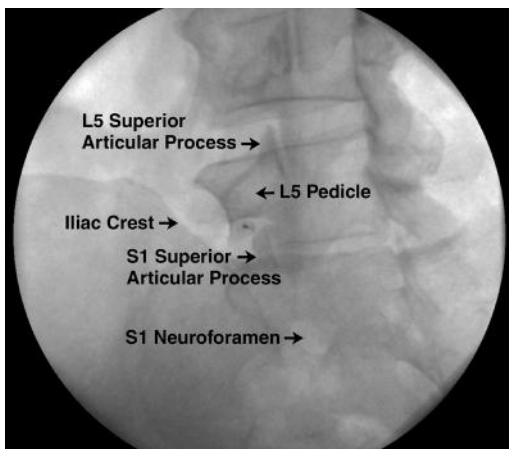
### Procedure

1. Prep and drape the patient in a sterile fashion in the prone position.
2. Identify the target level using fluoroscopic visualization in AP view.
3. Tilt the fluoroscope cephalad or caudad to square the superior endplate.
4. Oblique the C-arm ipsilaterally until the target neural foramen is visualized.
5. Using a 25-gauge needle, anesthetize the skin over the site of entry with 1% lidocaine.
6. Insert spinal needle over the anesthetized skin, parallel to the trajectory of the fluoroscope.
7. Using intermittent fluoroscopy, advance the needle toward the superior, lateral, and anterior aspect of the neural foramen (“safe triangle”) (Figure 8.5).

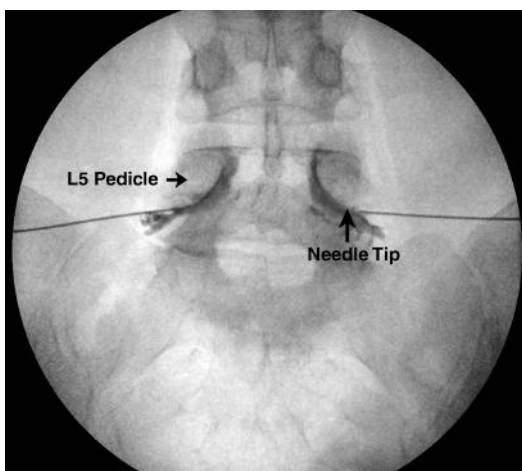
8. Use biplanar imaging to advance the needle toward the six o'clock position of the pedicle (in AP view) and anterior to the spinolaminar line (in lateral view).
9. Connect extension tubing to the needle and under live fluoroscopy inject contrast dye to assure no intrathecal or intravascular penetration (Figures 8.6 and 8.7).
10. Inject the steroid mixture.
11. Observe the patient postprocedure to assure no adverse reaction.

### **Pearls**

- Inadvertent intravascular injection can result in embolization of vascular structures and infarction.
- Biplanar imaging should be performed to adequately visualize depth.
- The L5 neural foramen may sometimes be occluded by a prominent iliac crest; a cephalad tilt can help clear the crest to visualize the foramen.
- The "safe triangle" refers to a fluoroscopic region just lateral to the inferior margin of the pedicle, dorsal to the vertebral body and cephalad to the nerve root.
- Dexamethasone should be considered for the upper lumbar levels due to an increased risk of intravascular penetration of the Artery of Adamkiewicz.
- Vascular uptake is seen as rapidly dissipating contrast during live fluoroscopy.



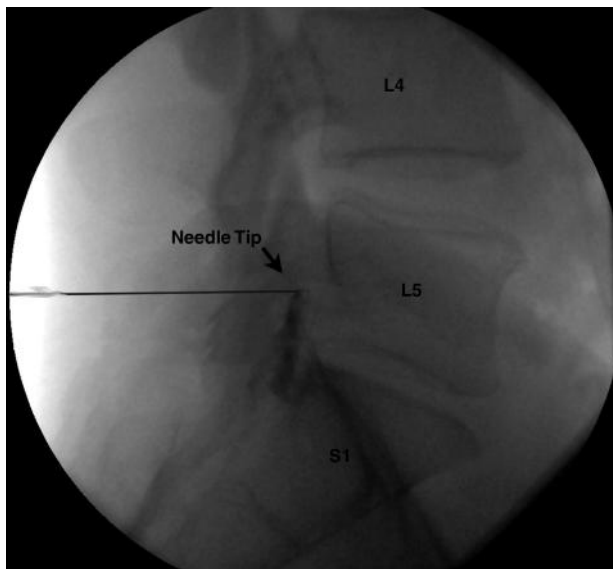
**Figure 8.5** Needle in oblique view for left L5 TFESI.



**Figure 8.6** Postcontrast bilateral lumbar TFESI in AP view.

*(Continued)*





**Figure 8.7** Postcontrast lumbar TFESI in lateral view.

### S1 TRANSFORAMINAL EPIDURAL STEROID INJECTION (TFESI)

- **Indications:** lumbar radiculopathy, lumbar herniated nucleus pulposus, lumbar stenosis
- **Contraindications:** systemic or local site infection, bleeding diathesis, weakness
- **Needle:** 22- or 25-gauge, 3½ inch (or longer) Quincke spinal needle
- **Injectate volume:** 2 mL 0.9% normal saline (or 1% lidocaine) and 12 mg betamethasone (or 8–10 mg dexamethasone)
- **Contrast volume:** up to 4 mL
- **C-arm positions:** AP, ipsilateral oblique, lateral

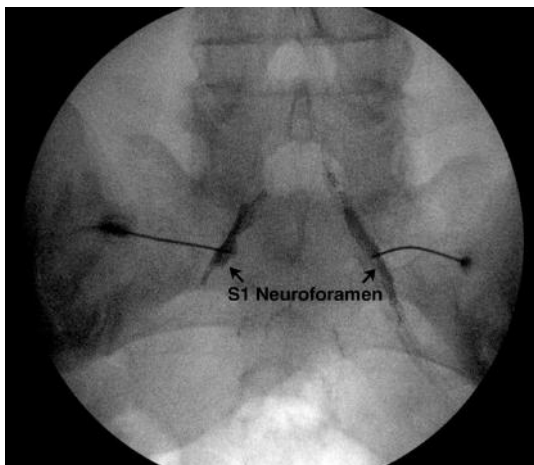
#### Procedure

1. Prep and drape the patient in a sterile fashion in the prone position.
2. Tilt the fluoroscope cephalad and oblique slightly ipsilaterally until the anterior and posterior S1 neural foramina are superimposed on one another. *Alternatively, the S1 neural foramen can also be visualized when the fluoroscope is obliqued as in an L5 TFESI (Figure 8.5).*
3. Using a 25-gauge needle, anesthetize the skin over the site of entry with 1% lidocaine.
4. Insert spinal needle over the anesthetized skin, parallel to the trajectory of the fluoroscope.
5. Using intermittent fluoroscopy, advance the needle toward the superior and lateral aspect of the S1 neural foramen.

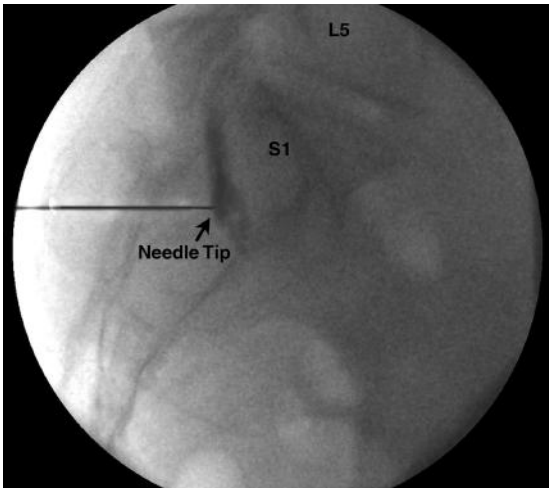
6. Use biplanar imaging to advance the needle within the sacral canal.
7. Connect extension tubing to the needle and under live fluoroscopy inject contrast dye to assure no intravascular penetration (Figures 8.8 and 8.9).
8. Inject the steroid mixture.
9. Observe the patient postprocedure to assure no adverse reaction.

### Pearls

- Inadvertent intravascular injection can result in embolization of vascular structures and infarction.
- Biplanar imaging should be performed to adequately visualize depth.
- Vascular uptake is seen as rapidly dissipating contrast during live fluoroscopy.



**Figure 8.8** Postcontrast bilateral S1 TFESI in AP view.



**Figure 8.9** Postcontrast S1 TFESI in lateral view.

**LUMBAR INTRA-ARTICULAR FACET INJECTION**

- **Indications:** painful lumbar facet arthropathy, axial lumbar pain
- **Contraindications:** systemic or local site infection, bleeding diathesis
- **Needle:** 22- or 25-gauge, 3½ inch (or longer) Quincke spinal needle
- **Injectate volume:** 0.5 mL 1% lidocaine and 3 mg beta-methasone
- **Contrast volume:** no more than 0.5 mL
- **C-arm positions:** AP, ipsilateral oblique, lateral

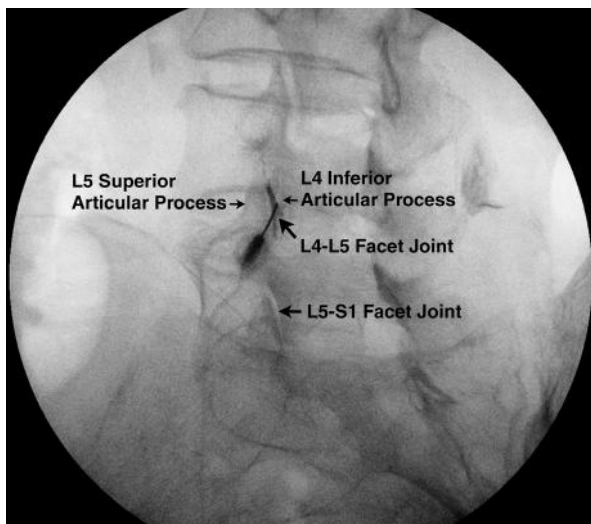
**Procedure**

1. Prep and drape the patient in a sterile fashion in the prone position.
2. Identify the target level using fluoroscopic visualization in AP view.
3. Tilt the fluoroscope cephalad or caudad to square the superior endplate.
4. Oblique the C-arm ipsilaterally until the most posterior aspect of the target facet joint is visualized.
5. Using a 25-gauge needle, anesthetize the skin over the site of entry with 1% lidocaine.
6. Insert spinal needle over the anesthetized skin, parallel to the trajectory of the fluoroscope.
7. Using intermittent fluoroscopy, advance the needle until entry within the facet joint (a subtle change of resistance is often felt).
8. Rotate the C-arm to the lateral position to confirm depth and assure that the needle is not placed too anteriorly within the neural foramen.

9. Connect extension tubing to the needle and under live fluoroscopy inject a trace amount of contrast dye. *An intra-articular pattern is usually seen as a straight line in the oblique view* (Figures 8.10 and 8.11).
10. Inject the steroid mixture.
11. Observe the patient postprocedure to assure no adverse reaction.

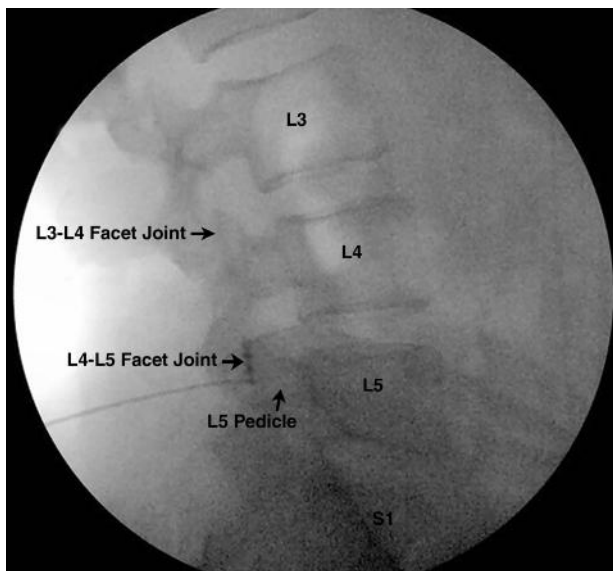
### Pearls

- Care must be taken not to place the needle either too laterally or too medially.
- The trajectory of the needle should be maintained in the mid-pedicular line.



**Figure 8.10** Postcontrast left lumbar facet joint injection in oblique view.

(Continued)



**Figure 8.11** Postcontrast lumbar facet joint injection in lateral view.

**LUMBAR MEDIAL BRANCH BLOCK (MBB)**

- **Indications:** diagnosis of painful lumbar facet arthropathy
- **Contraindications:** systemic or local site infection, bleeding diathesis
- **Needle:** 22- or 25-gauge, 3½ inch (or longer) Quincke spinal needle
- **Injectate volume:** 0.5 mL of 1% lidocaine (or 0.25%–0.75% bupivacaine) per medial branch
- **Contrast volume:** up to 0.5 mL
- **C-arm positions:** AP, ipsilateral oblique, lateral

**Procedure**

1. Prep and drape the patient in a sterile fashion in the prone position.
2. Identify the target level using fluoroscopic visualization in AP view.
3. Tilt the fluoroscope cephalad or caudad to square the superior endplate.
4. Oblique the fluoroscope ipsilaterally to visualize the “eye” of the “scotty dog,” that is, the target point of the injection (L1–L4 medial branches). This correlates to the junction of the superior articular process and the transverse process.
5. For the L5–S1 facet joint, the target is the L5 dorsal ramus which is located at the junction of the ala of the sacrum and the base of the S1 superior articular process.
6. Using a 25-gauge needle, anesthetize the skin over the site of entry with 1% lidocaine.

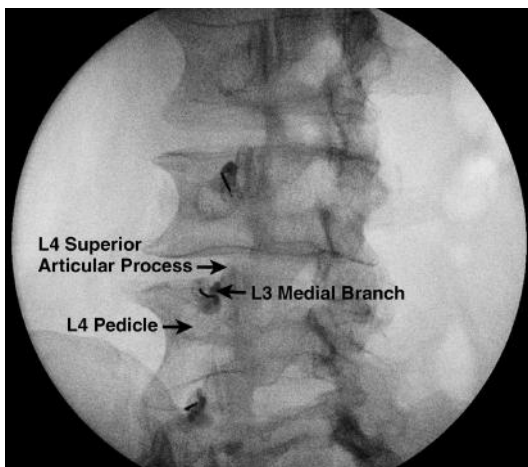


7. Insert spinal needle over the anesthetized skin, parallel to the trajectory of the fluoroscope.
8. Advance the needle until periosteum is engaged (“bony contact”).
9. Use biplanar imaging in the AP and lateral position to assure adequate needle depth.
10. Connect extension tubing to the needle and under live fluoroscopy inject contrast dye to assure no intravascular penetration (Figures 8.12, 8.13, and 8.14).
11. Inject anesthetic mixture.
12. Observe the patient postprocedure to assure no adverse reaction.

## **Pearls**

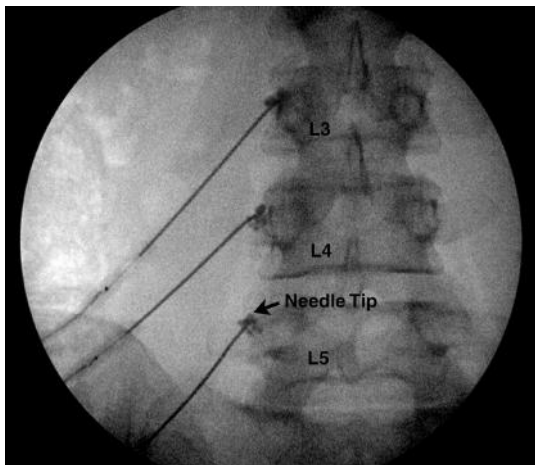
- The nomenclature of the lumbar medial branches do not match the nomenclature of the targeted facet joint. Care should be taken to ensure that the appropriate medial branch for the appropriate facet joint is targeted.
- For example, the L4-5 facet joint is innervated by the L3 and L4 medial branches. These medial branches cross the L4 and L5 transverse process respectively. Therefore, to block the L3 medial branch, the L4 spinal level is targeted ( $N-1$  = medial branch to be blocked, where N is the spinal level targeted).
- The iliac crest may pose an anatomic barrier to the L5 dorsal ramus if the same obliquity is used. Often times it is necessary to use a slightly less oblique view to access this level.

- Care should be taken not to contact the ventral ramus of the spinal nerve by maintaining the needle tip on the periosteum, with the bevel oriented medial and inferior.
- The patient should be given a pain diary to document pain levels following the procedure, every 15 minutes for the first 2 hours, and then every hour for the next 12 hours. A positive response is noted as greater than 75% pain relief lasting for the duration of the anesthetic agent.
- The recommendation is to utilize a double block paradigm: first medial branch block with lidocaine; if a positive response is noted, then repeat the block with bupivacaine in 1 to 2 weeks. If a positive response is noted again, then proceed toward radiofrequency ablation of those medial branches.

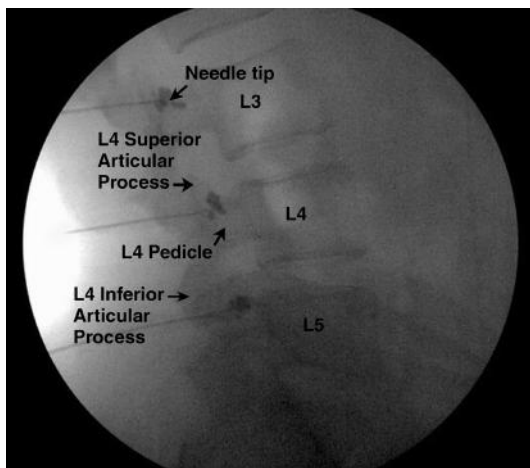


**Figure 8.12** Postcontrast left lumbar MBB in oblique view.

*(Continued)*



**Figure 8.13** Postcontrast left lumbar MBB in AP view.



**Figure 8.14** Postcontrast lumbar MBB in lateral view.

## SUGGESTED READINGS

- Bogduk N, ed. *Practice Guidelines for Spinal Diagnostic and Treatment Procedures*. 2nd ed. San Francisco, CA: International Spine Intervention Society (ISIS); 2013.
- Dreyfuss PH, Dreyer SJ, Herring SA. Contemporary concepts in spine care: lumbar zygapophyseal (facet) joint injections. *Spine*. 1995;20:2040–2047.
- Fenton DS, Czervionke LF. *Image Guided Spine Intervention*. Philadelphia, PA: Saunders Elsevier; 2003.
- Fish DE, Lee PC, Marcus DB. The S1 “Scotty dog”: report of a technique for S1 transforaminal epidural steroid injection. *Arch Phys Med Rehabil*. 2007;88(12):1730–1733.
- Furman M, Jasper NR, Lin H. Fluoroscopic contralateral oblique view in interlaminar interventions: a technical note. *Pain Med*. 2010;13:1389–1396.
- Park JW, Nam HS, Cho SK, Jung HJ, Lee BJ, Park Y. Kambin's triangle approach of lumbar transforaminal epidural injection with spinal stenosis. *Ann Rehabil Med*. 2011;35(6):833–843.
- Pauza K. Educational guidelines for interventional spinal procedures. 2008. [www.aapmr.org/practice/guidelines/Documents/edguidelines.pdf](http://www.aapmr.org/practice/guidelines/Documents/edguidelines.pdf). Accessed June 2013.
- Slipman C, Derby R, Simeone F, Mayer T, eds. *Interventional Spine: An Algorithmic Approach*. Philadelphia, PA: Saunders Elsevier; 2008.



## CHAPTER 9

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# Hip, Sacroiliac Joint, and Coccyx Injections

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*Anupam Sinha, Theodore D. Conliffe, and William Anderson*

### HIP INTRA-ARTICULAR INJECTION

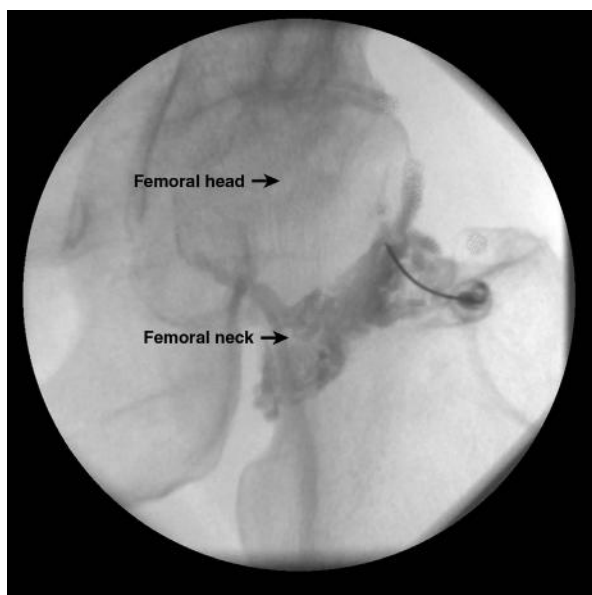
- **Indications:** hip degenerative joint disease, femoral acetabular impingement, labral or acetabular injury
- **Contraindications:** systemic or local site infection, bleeding diathesis, weakness
- **Needle:** 22-gauge, 3½ inch (or larger) Quincke needle
- **Injectate:** 4 mL 1% lidocaine and 40 mg triamcinolone
- **Contrast volume:** up to 4 mL
- **C-arm positions:** Anteroposterior (AP), ipsilateral oblique

Procedure
<ol style="list-style-type: none"><li>1. Prep and drape the patient in a sterile fashion in the supine position.</li><li>2. Under fluoroscopic visualization, identify the femoral acetabular joint in AP view.</li></ol>

3. The target is the junction of the femoral neck and femoral head.
4. Oblique the C-arm slightly ipsilaterally to stay lateral to the femoral vessels (palpate the femoral pulse and stay lateral to this line).
5. Using a 25-gauge needle, anesthetize the skin over the site of entry with 1% lidocaine.
6. Insert spinal needle over the anesthetized skin, parallel to the trajectory of the fluoroscope.
7. Using intermittent fluoroscopy, advance the needle until periosteum is engaged (“bony contact”).
8. Connect extension tubing to the needle and under live fluoroscopy inject contrast dye to assure no intravascular penetration (Figure 9.1).
9. Inject steroid mixture.
10. Observe the patient postprocedure to assure no adverse reaction.

### **Pearls**

- Care should be taken not to insert the needle too far medially to avoid puncturing the femoral nerve, vein, or artery. Always stay lateral to the femoral pulse.
- A femoral nerve block will produce hip flexor and knee extensor weakness.
- Hip injections may serve as a useful diagnostic tool to differentiate hip and groin pain resulting from hip pathology versus upper lumbar radiculopathy.



**Figure 9.1** Postcontrast left hip intra-articular injection.



## SACROILIAC JOINT INJECTION

- **Indications:** buttock pain, low back pain, hip pain in absence of neurologic signs, sacroiliac (SI) joint arthropathy, confirm diagnosis of SI joint dysfunction
- **Contraindication:** local or systemic infection, bleeding diathesis
- **Needle:** 22- or 25-gauge, 3½ inch (or longer) Quincke spinal needle
- **Injectate:** 1 mL 1% lidocaine and 12 mg betamethasone (or 40 mg triamcinolone)
- **Contrast volume:** up to 0.5 mL
- **C-arm positions:** ipsilateral or contralateral oblique, AP, lateral

### Procedure

#### Superimposed joint margin approach

1. Prep and drape the patient in a sterile fashion in the prone position.
2. Oblique the fluoroscope contralaterally to superimpose the anterior and posterior joint surfaces of the SI joint.
3. Using a 25-gauge needle, anesthetize the skin over the site of entry (the lower 1/3 of the visualized joint) with 1% lidocaine.
4. Insert spinal needle over the anesthetized skin, parallel to the trajectory of the fluoroscope.
5. Using intermittent fluoroscopy, advance the needle into the lower 1/3 of the joint.
6. Connect extension tubing to the needle and under live fluoroscopy inject contrast dye to assure no intravascular penetration (Figure 9.2).

7. Inject the steroid mixture.
8. Observe the patient postprocedure to assure no adverse reaction.

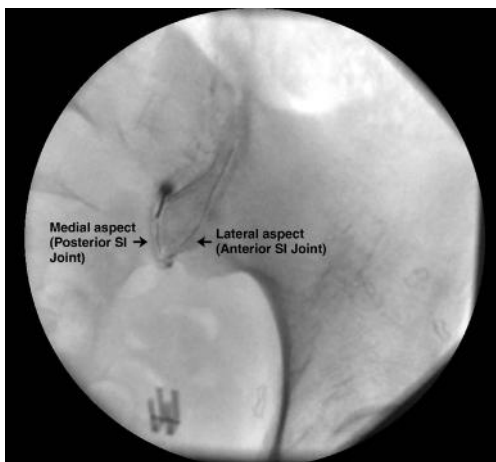
### **Separation of joint margins approach**

1. Prep and drape the patient in a sterile fashion in the prone position.
2. Oblique the fluoroscope ipsilaterally to separate the anterior (lateral) and posterior (medial) joint surfaces.
3. Using a 25-gauge needle, anesthetize the skin over the site of entry (lower 1/3 of the posterior/medial SI joint surface) with 1% lidocaine.
4. Insert spinal needle over the anesthetized skin, parallel to the trajectory of the fluoroscope.
5. Using intermittent fluoroscopy, advance the needle into the lower 1/3 of the posterior/medial joint.
6. Connect extension tubing to the needle and under live fluoroscopy inject contrast dye to assure no intravascular penetration; *contrast should fill both the medial and lateral aspects of the joint to assure posterior–anterior spread of medication* (Figure 9.3).
7. Inject the steroid mixture.
8. Observe the patient postprocedure to assure no adverse reaction.

(Continued)



**Figure 9.2** Postcontrast SI Joint injection (superimposed anterior and posterior joints) in contralateral oblique view.



**Figure 9.3** Postcontrast SI joint injection (separation of anterior and posterior joints) in ipsilateral oblique view.

### **Pearls**

- Postprocedure pain relief may be documented with a pain diary to confirm the diagnosis of SI dysfunction.
- A cranial or caudal tilt of the C-arm can often provide optimal visualization of the SI joint.
- Anatomically the upper 2/3 of the joint is fibrotic and is difficult to enter with a needle.
- As the needle enters the joint the needle tip appears to bend.
- The SI joints can often be a source of low back pain following lower lumbar fusion.

**GANGLION IMPAR BLOCK**

- **Indications:** coccydynia, pelvic pain, perineal pain of benign, or malignant origin
- **Contraindications:** local or systemic infection, bleeding diathesis
- **Needle:** 22- or 25-gauge, 3½ inch spinal needle
- **Injectate:** 4 mL 1% lidocaine (or 0.25% bupivacaine) and 6 mg betamethasone (or 40 mg triamcinolone)
- **Contrast volume:** up to 1 to 2 mL
- **C-arm positions:** AP, lateral. AP view may need to be tilted to adequately visualize the sacrococcygeal or intercoccygeal disc space

**Procedure**

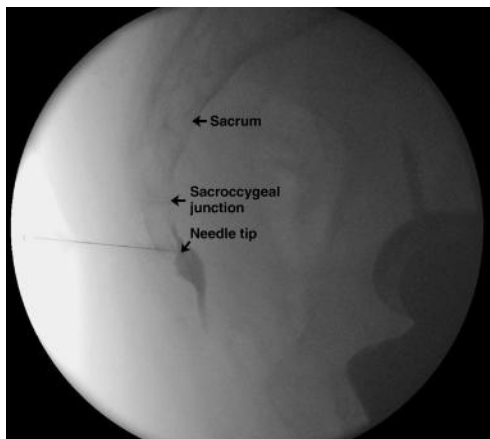
1. Prep and drape the patient's sacral and gluteal areas in a sterile fashion in the prone position.
2. Using fluoroscopic visualization, identify either the sacrococcygeal or intercoccygeal disc space in AP view. The target is the center of either disc space.
3. Using a 25-gauge needle, anesthetize the skin over the site of entry with 1% lidocaine.
4. Insert spinal needle over the anesthetized skin.
5. Using intermittent fluoroscopy, advance the needle directly toward the center of the disc space until resistance is encountered.
6. Under lateral view, advance the needle carefully through the disc space using intermittent fluoroscopy until the needle tip is seen just anterior to the coccyx.

7. Confirm midline needle position in AP view.
8. Connect extension tubing to the needle and under live fluoroscopy inject contrast dye in lateral view to assure no intravascular penetration. Dye should spread anterior to the coccyx with a “reverse comma” appearance (Figures 9.4 and 9.5).
9. Inject the steroid mixture.
10. Observe the patient postprocedure to assure no adverse reaction.

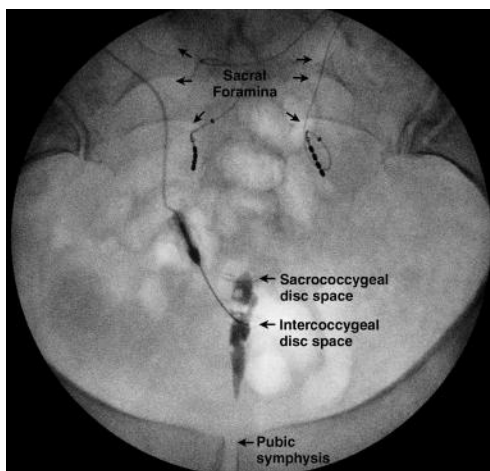
### Pearls

- Consideration should be given to advanced imaging of the pelvis to evaluate for underlying medical cause of pain such as malignancy and to rule out infection.
- Regardless of patient body habitus, subcutaneous tissue coverage is scant and, if resistance to needle advancement is not encountered after advancing the needle 1 to 2 cm, AP view should be obtained to verify that the needle is at midline and lateral view should be obtained to verify needle depth.
- If bony resistance is encountered, use lateral view to adjust needle position and approach angle so that needle can be passed through the disc space.
- Consider rotating the needle during advancement in tight spaces.
- Prior to inserting the spinal needle, 1% lidocaine may also be used to anesthetize the posterior fibers of the coccygeal nerve along the posterior aspect of the coccyx.

*(Continued)*



**Figure 9.4** Postcontrast ganglion impar injection in lateral view.



**Figure 9.5** Postcontrast ganglion impar injection in AP view.

## SUGGESTED READINGS

- Benzon HT, Raj PP. *Raj's Practical Management of Pain*. Philadelphia, PA: Mosby-Elsevier; 2008.
- Fenton DS, Czervionke LF. *Image Guided Spine Intervention*. Philadelphia, PA: Saunders Elsevier; 2003.
- Hong JH, Jang HS. Block of the ganglion impar using a coccygeal joint approach. *Reg Anesth Pain Med*. 2006;31(6):583–584.
- Maigne JY, Planchon CA. Sacroiliac joint pain after lumbar fusion. A study with anesthetic blocks. *Eur Spine Jrl*. 2005;14:654–658.
- Patijn J, Janssen M, Hayek S, Mekhail N, Van Zundert J, van Kleef M. Coccygodynia. *Pain Pract*. 2010;10(6):554–559.
- Scott-Warren JT, Hill V, Rajasekaran A. Ganglion impar blockade: a review. *Curr Pain Headache Rep*. 2013;17(1):306.
- Slipman C, Derby R, Simeone F, Mayer T, eds. *Interventional Spine: An Algorithmic Approach*. Philadelphia, PA: Saunders Elsevier; 2008.
- Toshinwal GR, Dureja GP, Prashanth SM. Transsacrococcygeal approach to ganglion impar block for management of chronic perineal pain: a prospective observational study. *Pain Physician*. 2007;10:661–666.





## CHAPTER 10

# Epidural Blood Patch

*George Young*

### EPIDURAL BLOOD PATCH

- **Indications:** postdural puncture headache, spontaneous intracranial hypotension
- **Contraindications:** systemic or local site infection, bleeding diathesis
- **Needle:** 18- or 20-gauge, 3½ inch (or longer) Tuohy needle
- **Injectate:** 10 to 20 mL of autologous blood
- **Contrast volume:** up to 4 mL
- **C-arm positions:** AP, lateral, contralateral oblique

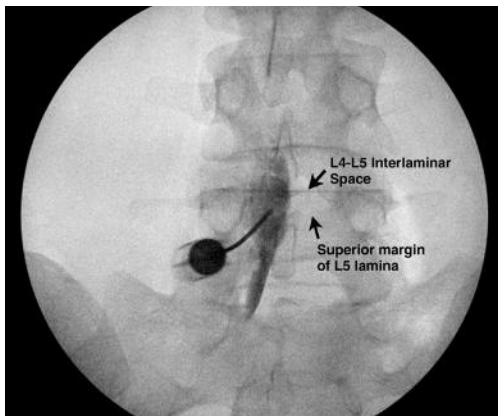
#### Procedure

1. Prep and drape the patient's lumbar region in a sterile fashion in the prone position.
2. Using fluoroscopic visualization, identify the target lumbar interlaminar space (L4-L5 or L5-S1) in AP view.
3. Tilt the fluoroscope cephalad or caudad to maximize the space and square the endplates.
4. Using a 25-gauge needle, anesthetize the skin over the site of entry with 1% lidocaine.

5. Insert Tuohy needle over the anesthetized skin.
6. An assistant should begin drawing blood from the patient using strict sterile technique.
7. Use biplanar imaging to advance the needle toward the spinolaminar line.
8. Use a loss of resistance technique and make sure there is negative aspirate for air, blood, and cerebrospinal fluid.
9. Connect extension tubing to the needle and under live fluoroscopy inject contrast dye to assure no intrathecal or intravascular penetration (Figures 10.1 and 10.2).
10. Inject the autologous blood.
11. After applying bandage, patient turns supine for 15 to 30 minutes.
12. Observe the patient postprocedure to assure no adverse reaction or new neurological deficit.

### **Pearls**

- Strict sterile technique is critical while drawing the patient's blood as it is an excellent growth medium for bacteria.
- If initial blood patch is not 100% effective, then repeat the blood patch within 24 to 48 hours.
- An epidural blood patch is always performed at the lumbar level regardless of the level of dural puncture.
- The contralateral oblique view (45°–60° from AP) can be used to better visualize the needle as it approaches the spinolaminar line, especially if needle position and landmarks are poorly visualized in a lateral view due to large body habitus, severe osteoporosis, or the presence of bowel gas.



**Figure 10.1** Postcontrast epidural blood patch in AP view.



**Figure 10.2** Postcontrast epidural blood patch in lateral view.

*(Continued)*

## **SUGGESTED READING**

Safa-Tisseront V, Thormann F, Malassiné P, et al. Effectiveness of epidural blood patch in the management of post-dural puncture headache. *Anesthesiology*. 2001;95:334–339.

## **APPENDIX 1**

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# **Sample Procedure Dictations**

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Lumbar Interlaminar Epidural Steroid Injection	<b>94</b>
Lumbar Transforaminal Epidural Steroid Injection	<b>96</b>
Lumbar Intra-Articular Facet Joint Injection	<b>98</b>
Lumbar Medial Branch Blocks	<b>100</b>
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## **LUMBAR INTERLAMINAR EPIDURAL STEROID INJECTION**

**Level Injected:** Right L5-S1

**Indications:** Lumbar radiculopathy

The risks, benefits, and alternatives of the procedure were discussed extensively with the patient. Risks discussed included, but were not limited to, bleeding, infection, allergic reaction, and structural damage. Written informed consent was obtained from the patient and then the following procedure was performed.

The patient was placed on the fluoroscopy table in the prone position with a lumbar roll in place under the abdominal area. The lumbar area was then prepped and draped in the usual sterile fashion. Fluoroscopy was used to identify the target levels as noted above. Using sterile technique, the superficial skin was anesthetized with 1% lidocaine without epinephrine using a 25-gauge 1.5 inch needle. Next, an 18-gauge 3.5 inch Tuohy needle was introduced into the epidural space at the right L5-S1 interspace under intermittent fluoroscopic guidance using loss of resistance technique. A dry tap was obtained. Multiplanar fluoroscopic imaging was also used to verify needle placement, and extension tubing was then attached to the spinal needle. Then, under live fluoroscopy, 2 mL Omnipaque 240 mg was injected into the epidural space. There was evidence of good epidural flow. After aspiration was negative for return of blood or cerebrospinal fluid (CSF), a solution of 3 mL of 1% lidocaine with 12 mg of betamethasone was injected into the epidural space.

The needle was then removed. No blood or CSF was noted to be draining, and a sterile bandage was applied after pressure was applied with a gauze pad. Vital signs remained normal and were monitored in the recovery area. The patient

tolerated the procedure well. There were no complications noted and no new neurological complaints.

The patient was advised to apply ice over the injection site for 10 to 15 minutes over the next 24 to 48 hours, every 3 to 4 hours. The patient was instructed to contact the physician's office if there were any problems. A postprocedure instruction sheet was given.



## **LUMBAR TRANSFORAMINAL EPIDURAL STEROID INJECTION**

**Level Injected:** Left L5-S1

**Indications:** Lumbar radiculopathy

The risks, benefits, and alternatives of the procedure were discussed extensively with the patient. Risks discussed included, but were not limited to, bleeding, infection, allergic reaction, and structural damage. Written informed consent was obtained from the patient and then the following procedure was performed.

The patient was placed in the prone position on the fluoroscopy table. The lumbar area was prepped and draped in the usual sterile fashion. The C-arm was rotated to an ipsilateral oblique position and the appropriate neuroforamen was identified under fluoroscopic guidance. Using sterile technique the superficial skin was anesthetized with 1% lidocaine without epinephrine using a 25-gauge 1.5 inch needle. Using sterile technique a 22-gauge 5-inch needle was inserted into the skin. Under intermittent fluoroscopic guidance, the needle was advanced toward the uppermost aspect of the superior articular process and just inferior to the pedicle. The C-arm was then rotated to the anteroposterior (AP) view and the needle was advanced to the six o'clock position inferior to the pedicle. Multiplanar fluoroscopic imaging was also used to verify needle placement, and extension tubing was then attached to the spinal needle. Then, under live fluoroscopy, 2 mL of contrast dye was injected into the epidural space. There was evidence of good epidural flow and nerve root spread. No vascular uptake was noted. After aspiration was negative for return of blood or CSF, a solution of 2 mL of 1% lidocaine and 12 mg of betamethasone was injected into the left neuroforamen at the L5-S1 level. The needle was then removed.

No blood or CSF was noted to be draining from the injection site(s), and a sterile bandage was applied after pressure was applied with a gauze pad. Vital signs remained normal and were monitored in the recovery area. The patient tolerated the procedure well. There were no complications noted and no new neurological complaints.

The patient was advised to apply ice over the injection site(s) for 10 to 15 minutes over the next 24 to 48 hours, every 3 to 4 hours. The patient was instructed to contact the physician's office if there were any problems. A postprocedure instruction sheet was given.

## **LUMBAR INTRA-ARTICULAR FACET JOINT INJECTION**

**Level Injected:** Left L4-5 and L5-S1

**Indications:** Low back pain

The risks, benefits, and alternatives of the procedure were discussed extensively with the patient. Risks discussed included, but were not limited to, bleeding, infection, allergic reaction, and structural damage. Written informed consent was obtained from the patient and then the following procedure was performed.

The patient was placed in the prone position on the fluoroscopy table. The lumbar area was prepped and draped in the usual sterile fashion. The C-arm was rotated to an ipsilateral oblique position and the target lumbar facet joints were identified under fluoroscopy. Using sterile technique, the superficial skin over each facet joint was anesthetized with 1% lidocaine without epinephrine using a 25-gauge 1.5 inch needle. Next, at each site, a 22-gauge 3.5-inch needle was inserted into the skin. Under intermittent fluoroscopic guidance, the needles were advanced in a bull's-eye fashion until correct positioning in the L4-5 and L5-S1 lumbar facet joints was noted. Extension tubing was then attached to the needles and then under live fluoroscopy, 0.5 mL of contrast was injected at each level to verify proper positioning of the needle. No vascular uptake was noted. After aspiration was negative for return of blood, a solution of 0.5 mL of 1% lidocaine and 3 mg of betamethasone was injected into each of the target lumbar facet joints. The needles were then removed.

No blood or CSF was noted to be draining from the injection site(s), and a sterile bandage was applied after pressure was applied with a gauze pad. Vital signs remained normal and were monitored in the recovery area. The patient tolerated

the procedure well. There were no complications noted and no new neurological complaints.

The patient was advised to apply ice over the injection site(s) for 10 to 15 minutes over the next 24 to 48 hours, every 3 to 4 hours. The patient was instructed to contact the physician's office if there are any problems. A postprocedure instruction sheet was given. In addition, the patient was advised to monitor their symptoms closely for a diagnostic and/or therapeutic response and use a pain diary if necessary.

## **LUMBAR MEDIAL BRANCH BLOCKS**

**Level Injected:** Left L3, L4, and L5 medial branches

**Indications:** Low back pain

The risks, benefits, and alternatives of the procedure were discussed extensively with the patient. Risks discussed included, but were not limited to, bleeding, infection, allergic reaction, and structural damage. Written informed consent was obtained from the patient and then the following procedure was performed.

The patient was placed in the prone position on the fluoroscopy table. The lumbar area was prepped and draped in the usual sterile fashion. The C-arm was rotated to an ipsilateral oblique position and the boney landmarks for the target medial branches were identified under fluoroscopy. Using sterile technique, the superficial skin over each medial branch was anesthetized with 1% lidocaine without epinephrine using a 25-gauge 1.5 inch needle. Next, at each site, a 22-gauge 3.5-inch needle was inserted into the skin. Under intermittent fluoroscopic guidance, the needles were positioned at the target site of the traversing left L3, L4, and L5 medial branches. The needle was advanced to abut the bone at the junction of the superior articular process and the transverse process for at each of the target medial branches, except for the L5 dorsal ramus where the needle was directed to abut bone at the junction of the superior articular process and the sacral ala. Extension tubing was then attached to the needles and under live fluoroscopy, 0.5 mL of contrast dye was injected at each site to verify proper positioning of the needle. No vascular uptake was noted. After aspiration was negative for return of blood, a solution of 0.5 mL of 1% lidocaine was injected at each level. The needles were then removed.

No blood or CSF was noted to be draining from the injection site(s), and a sterile bandage was applied after pressure was

applied with a gauze pad. Vital signs remained normal and were monitored in the recovery area. The patient tolerated the procedure well. There were no complications noted and no new neurological complaints.

The patient was advised to apply ice over the injection site(s) for 10 to 15 minutes over the next 24 to 48 hours, every 3 to 4 hours. The patient was instructed to contact the physician's office if there were any problems. A postprocedure instruction sheet was given. In addition, the patient was advised to monitor their symptoms closely for a diagnostic and/or therapeutic response and use a pain diary if necessary.

## CAUDAL EPIDURAL STEROID INJECTION

**Indications:** Lumbar radiculopathy

The risks, benefits, and alternatives of the procedure were discussed extensively with the patient. Risks discussed included, but were not limited to, bleeding, infection, allergic reaction, and structural damage. Written informed consent was obtained from the patient and then the following procedure was performed.

The patient was placed on the fluoroscopy table in the prone position with a lumbar roll in place under the abdominal area. The sacral area was then prepped and draped in the usual sterile fashion. The C-arm was rotated to a lateral view and the sacral hiatus was identified under fluoroscopy. Using sterile technique, the superficial skin was anesthetized with 1% lidocaine without epinephrine using a 25-gauge 1.5 inch needle. Then, a 22-gauge 3.5-inch needle was inserted into the skin. Under intermittent fluoroscopic guidance, the needle was introduced into the caudal epidural space via the sacral hiatus. It was advanced approximately to the S3 level. Multiplanar fluoroscopic imaging with AP and lateral views was used to further verify correct needle placement. Extension tubing was then attached to the spinal needle and under live fluoroscopy 2 mL of contrast dye was injected into the epidural space. There was evidence of good epidural flow. No vascular uptake was noted. After aspiration was negative for return of blood or CSF, a solution of 5 mL of 0.9% normal saline, 3 mL of 1% lidocaine, and 12 mg of betamethasone was injected. The needle was then removed.

No blood or CSF was noted to be draining, and a sterile bandage was applied after pressure was applied with a gauze pad. Vital signs remained normal and were monitored in the recovery area. The patient tolerated the procedure well.

There were no complications noted and no new neurological complaints.

The patient was advised to apply ice over the injection site for 10 to 15 minutes over the next 24 to 48 hours, every 3 to 4 hours. The patient was instructed to contact the physician's office if there were any problems. A postprocedure instruction sheet was given.



## **GANGLION IMPAR INJECTION**

### **Indications:** Coccydynia

The risks, benefits, and alternatives of the procedure were discussed extensively with the patient. Risks discussed included, but were not limited to, bleeding, infection, allergic reaction, and structural damage. Written informed consent was obtained from the patient and then the following procedure was performed.

The patient was placed in the prone position on the fluoroscopy table. The skin overlying the sacrococcygeal area was prepped and draped in the usual sterile fashion. The C-arm was rotated to a lateral view to visualize the sacrum and coccyx, with the sacrococcygeal junction used as a landmark. Using sterile technique, the superficial skin was anesthetized with 1% lidocaine without epinephrine using a 25-gauge 1.5 inch needle. Then, a 22-gauge 3.5-inch needle was inserted into the skin. Under intermittent fluoroscopic guidance, the needle was advanced into the sacrococcygeal junction. The needle was then advanced in lateral view, gently through the segment until it was placed appropriately just at the anterior aspect of the coccyx. Next, aspiration revealed no return of blood or other fluid. Extension tubing was then attached to the spinal needle and under live fluoroscopy, 2 mL of contrast dye was injected. There was good longitudinal spread of the contrast just anterior to the sacrum and coccyx, thus covering the ganglion Impar. There was no evidence of contrast filling in the rectum. No evidence of vascular uptake was noted. Proper placement was also confirmed in the AP view. Next a solution of 4 mL of 1% lidocaine and 6 mg of betamethasone was injected. The needle was then removed.

No blood or CSF was noted to be draining, and a sterile bandage was applied after pressure was applied with a gauze pad. Vital signs remained normal and were monitored in

the recovery area. The patient tolerated the procedure well. There were no complications noted and no new neurological complaints.

The patient was advised to apply ice over the injection site for 10 to 15 minutes over the next 24 to 48 hours, every 3 to 4 hours. The patient was instructed to contact the physician's office if there were any problems. A postprocedure instruction sheet was given.

## **SACROILIAC JOINT INJECTION**

**Side:** Left

**Indications:** Low back pain

The risks, benefits, and alternatives of the procedure were discussed extensively with the patient. Risks discussed included, but were not limited to, bleeding, infection, allergic reaction, and structural damage. Written informed consent was obtained from the patient and then the following procedure was performed.

The patient was placed in the prone position on the fluoroscopy table. The skin overlying the lumbosacral area was prepped and draped in the usual sterile fashion. The C-arm was rotated to a slightly ipsilateral oblique view to separate the medial and lateral aspects of the sacroiliac joint. Using sterile technique, the superficial skin was anesthetized with 1% lidocaine without epinephrine using a 25-gauge 1.5 inch needle. Then, a 22-gauge 3.5-inch needle was inserted into the skin. Under intermittent fluoroscopic guidance, the needle was advanced into the inferior third of the medial aspect of the left sacroiliac joint. Extension tubing was then attached to the spinal needle and under live fluoroscopy 0.5 mL of contrast dye was injected into the sacroiliac joint space. No vascular uptake was noted. There was evidence of good contrast flow into the medial and lateral aspects of the left sacroiliac joint. After aspiration was negative for return of blood or other fluid, a solution of 1 mL of 1% lidocaine and 12 mg of betamethasone was injected. The needle was then removed.

No blood was noted to be draining, and a sterile bandage was applied after pressure was applied with a gauze pad. Vital signs remained normal and were monitored in the recovery

area. The patient tolerated the procedure well. There were no complications noted and no new neurological complaints.

The patient was advised to apply ice over the injection site for 10 to 15 minutes over the next 24 to 48 hours, every 3 to 4 hours. The patient was instructed to contact the physician's office if there were any problems. A postprocedure instruction sheet was given.

## **INTRA-ARTICULAR HIP INJECTION**

**Side:** Left

**Indications:** Hip degenerative joint disease

The risks, benefits, and alternatives of the procedure were discussed extensively with the patient. Risks discussed included, but were not limited to, bleeding, infection, allergic reaction, and structural damage. Written informed consent was obtained from the patient and then the following procedure was performed.

The patient was placed in the supine position on the procedure table. An anterolateral approach was used. The skin overlying the target injection site at the left anterior thigh was prepped and draped in the usual sterile manner. Using sterile technique, the superficial skin was anesthetized with 1% lidocaine without epinephrine using a 25-gauge 1.5 inch needle. Then, a 22-gauge 5-inch needle was inserted into the skin. Using intermittent fluoroscopic guidance, the needle was advanced toward the left hip joint until bony contact. Aspiration was attempted and no fluid was aspirated. No blood was returned. Extension tubing was then attached to the spinal needle and under live fluoroscopy 2 mL of contrast dye was injected. There was evidence of good contrast flow into the joint capsule. No vascular uptake was noted. Next, a solution of 4 mL of 1% lidocaine and 40 mg of kenalog was injected. The patient noted no paresthesias into the leg with needle placement and injection of medication. The needle was then removed.

No blood was noted to be draining, and a sterile bandage was applied after pressure was applied with a gauze pad. Vital signs remained normal and were monitored in the recovery area. The patient tolerated the procedure well.

There were no complications noted and no new neurological complaints.

The patient was advised to apply ice over the injection site for 10 to 15 minutes over the next 24 to 48 hours, every 3 to 4 hours. The patient was instructed to contact the physician's office if there were any problems. A postprocedure instruction sheet was given.



## APPENDIX 2

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# Sample Procedure Consent Form

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**Patient:** \_\_\_\_\_

**Date of Procedure:** \_\_\_\_\_

- I hereby authorize Dr. \_\_\_\_\_ to perform on me the following procedure(s): \_\_\_\_\_.
  - I have read this document and I have consulted with the physician about this procedure and alternative treatments.
  - I understand that the potential benefits of the procedure may include improved or resolved pain and improved function.
  - I acknowledge that no guarantee or assurance has been made as to the results that may be obtained. The procedure may initially increase pain in the area or reproduce my symptoms and then may decrease my pain. It is possible that the procedure can create new pain in the neck, back, or extremities.
  - I acknowledge that certain risks and hazards can occur, regardless of the skill, care, and experience of the physician. The risks include, but are not limited to: bleeding, infection, inadvertent spinal puncture with or without spinal headaches, allergic reaction, seizures, renal failure,
-



fainting, nerve damage, stroke, paralysis, cardiovascular collapse, and death.

- I understand that steroids may be injected for a therapeutic benefit and pain relief, but are associated with risks that include, but are not limited to: elevated blood sugars, elevated blood pressure, headache, insomnia, irritability, hiccups, early onset of glaucoma, osteoporosis, facial flushing, swelling, and avascular necrosis.
- I will allow for the physician performing the procedure to determine if a change in the approach or level of the injection is necessary to obtain the desired results. If an adverse event should occur, I request and authorize the physician to treat and stabilize the adverse condition.
- I have informed the physician of any allergy to local anesthetics, steroids, latex, intravenous contrast dye, shellfish, or iodine. If a true allergy to one of these agents exists, a substitute medication may be used or a prescription medication may be taken prior to prevent an allergic reaction.

**Patient Signature:** \_\_\_\_\_

**Physician Signature:** \_\_\_\_\_

**Witness Signature:** \_\_\_\_\_

**Date and Time:** \_\_\_\_\_

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